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Everett Harbor Action Program
Evaluation of Potential Contaminant Sources
Puget Sound Estuary Program

Tetra Tech, Inc., Bellevue, WA

Prepared for:

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The Puget Sound Urban Bay Action Program for Everett Harbor was initiated in 1985 by the U.S. Environmental Protection Agency, the Washington State Department of Ecology and other resource management agencies. Its purpose is to identify and control toxic contamination in the Port Gardner and lower Snohomish River areas of the harbor. This document reports the results of source sampling efforts.

Potential sources reviewed included: industrial facilities, wastewater treatment plants, combined sewer overflows, landfills, surface runoff pathways, groundwater, atmospheric deposition and spills. The source sampling program was designed as an initia screening survey that would identify problem chemicals in a limited number of sediments from drains discharging into Port Gardner and in groundwater samples from three monitoring wells at the Mukilteo Defense Fuel Supply Depot. Relationships between high-priority problem areas and potential sources of contamination were identified using available chemical data from the source sampling activities, sediment chemistry data from the receiving environment sampling effort and ancillary information on industrial activities and historical sources of contamination. More extensive sampling is needed before potential sources can be properly ranked for further investigation and control.

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Puget Sound Estuary Program

EVERETT HARBOR ACTION PROGRAM:

Evaluation of Potential Contaminant Sources

TC-3338-26
FINAL REPORT

September 1988

Prepared by
Tetra Tech, Inc.

Prepared for
U.S. Environmental Protection Agency
Region X — Office of Puget Sound
Seattle, Washington

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PREFACE

This document was prepared by Tetra Tech, Inc. for the U.S. Environmental Protection Agency (EPA) Region X, Office of Puget Sound, under the Everett Harbor Action Program work assignment of U.S. EPA Contract No. 68-02-4341. The primary objective of the Everett Harbor Action Program is to identify toxic contamination and appropriate corrective actions in Port Gardner and the lower Snohomish River. Corrective actions include source controls and sediment remedial actions. An Interagency Work Group (IAWG), comprising representatives from the U.S. EPA, Washington Department of Ecology (Ecology), and other resource management agencies, provides technical oversight for all work conducted under this work assignment.

In this report, potential contaminant sources in the Everett Harbor study area are evaluated. A revised action plan [PTI Environmental Services (PTI) 1988] was developed based on the findings of this study and on the recently completed analysis of toxic problem areas in the receiving environment (PTI and Tetra Tech 1988b).

The following reports are in preparation or have been drafted under the Everett Harbor Action Program:

- Analysis of toxic problem areas (PTI and Tetra Tech 1988b)
- Evaluation of potential contaminant sources (this report)
- Development of a revised action plan (PTI 1988).

TC 3338-26
Final Report

EVERETT HARBOR ACTION PROGRAM: EVALUATION OF POTENTIAL CONTAMINANT SOURCES

by

Tetra Tech, Inc.

for

U.S. Environmental Protection Agency
Region X - Office of Puget Sound
Seattle, Washington

September 1988

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This project was funded through the National Estuary Program under the authorities of the Clean Water Act as amended. Funding was approved by the U.S. EPA Office of Marine and Estuarine Protection. Ms. Clare Ryan and Dr. Lawrence McCrone served as technical monitors for U.S. EPA Region X throughout various phases of the project. Dr. Don Wilson served as the Tetra Tech Program Manager.

The primary authors of this report are Mr. Raymond Luce II, Mr. Robert Storer, Ms. Sharon Steele, and Ms. Lynne Kilpatrick-Howard of Tetra Tech. Dr. Jean Jacoby of Tetra Tech provided technical review of this document. Ms. Sue Trevathan of Tetra Tech performed technical editing and supervised report production. Collection of source samples was performed by Ms. Beth Schmoyer of Ecology, formerly of Tetra Tech; Mr. Pieter Booth of PTI, formerly of Tetra Tech; and Ms. Karen Keeley of Tetra Tech. Ms. Stacey Vineberg of Tetra Tech provided data management support. Assessment of chemical data quality was performed by Ms. Lynne Kilpatrick-Howard of Tetra Tech.

Technical guidance information was provided by representatives of many agencies and organizations including Mr. Dan Mathias, Mr. Carl Baird, Mr. Ron Thomas, and Mr. Jeff Kerwin of the City of Everett; Mr. David Wright and Mr. Dave Murdock, both of Ecology; Mr. Dennis Gregoire of the Port of Everett; Mr. Tim Bechtel of Scott Paper; and Mr. David Peterson, Snohomish County Health Department, Sanitation Division.

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The source sampling program was designed as an initial screening survey to identify the problem chemicals in a limited number of drains discharging into Port Gardner and in groundwater samples from three monitoring wells at the Mukilteo Defense Fuel Supply Depot. More extensive sampling is needed before potential sources can be properly ranked for further investigation and/or control.

The source evaluation section of this report focuses on the high-priority problem areas in the receiving environment that were identified in PTI and Tetra Tech (1988b). Relationships between the high-priority problem areas and potential sources of contamination were identified using available chemical data from the source sampling activities, sediment chemistry data from the receiving environment sampling effort, and ancillary information on industrial activities and historical sources of contamination.

OVERVIEW OF POTENTIAL SOURCES

Potential contaminant sources in the Everett Harbor study area can be divided into eight major point and nonpoint categories: industrial discharges, wastewater treatment plants, CSOs, landfills, surface runoff, groundwater, atmospheric deposition, and accidental spills. Industrial discharges are the permitted and nonpermitted discharges of process wastewater and stormwater runoff from commercial sites. There are four wastewater treatment plants that discharge treated wastewater into the study area. CSOs in the study area are part of the City of Everett's combined sewer system. Within Everett's North End Sewer System (NESS) there are 16 CSO outfalls (2 of which are deactivated). Eight of these outfalls discharge into Port Gardner and six discharge into the Snohomish River.

There are two landfills located within the study area. Contaminants from these landfills can be transported to waterways by direct overland flow, leaching, or by atmospheric deposition. Surface runoff is primarily considered a nonpoint source and occurs when excess precipitation washes off the land surface and discharges to the waterways through natural drainages

EXECUTIVE SUMMARY

INTRODUCTION

In 1985, the Everett Harbor Action Program was initiated by the U.S. EPA, Ecology, and other resource management agencies to identify and control toxic contamination in Port Gardner and the lower Snohomish River. The Everett Harbor project area includes the Snohomish River estuary east to Interstate 5 (I-5), the nearshore areas of Port Gardner, the Snohomish River delta, and the lower Snohomish River estuary (Figure ES-1).

During October of 1986, sampling was conducted in the nearshore receiving environment and in several combined sewer overflows (CSOs) and storm drains discharging into the project area. The source sampling approach was based on a technique originally developed by the Municipality of Metropolitan Seattle (Metro), in which contaminants are traced to their ultimate sources through the collection and chemical analysis of in-line sediment samples from individual drains (Metro 1985; Sample 1987; Hubbard and Sample 1988). Groundwater samples were also collected from existing monitoring wells at the Mulkilteo Defense Fuel Supply Depot. Results of the receiving environment sampling effort are presented in PTI and Tetra Tech (1988b). The results of the source sampling effort are the subject of this document.

The evaluation of potential contaminant sources in Port Gardner and the lower Snohomish River provided in this document has two major components:

- Identification of problem chemicals in the source samples

- Identification of relationships between potential sources of contaminants and the high-priority problem areas identified in the receiving environment (PTI and Tetra Tech 1988b).

Based on the large number of problem chemicals common to both CSO E011 and stations in East Waterway (and the relative distributions of the chemicals), it is likely that CSO E011 contributed to chemical contamination of sediments in East Waterway, especially 4-methylphenol and PAH contamination. However, there were probably other significant sources of contamination in the vicinity of CSO E011, especially for compounds related to the pulp industry.

The results from the chemical analysis of the sediment sampled from CSO E007 suggest that the CSO may have been a source of the total high molecular weight polynuclear aromatic hydrocarbons (HPAH) and metals found in the East Waterway. The sediment sample from CSO E007 was not analyzed for pulp mill compounds.

Nearshore Port Gardner Problem Area

Polar organic compounds (e.g., 4-methylphenol, benzoic acid, and phenol) were the major contaminants in the sediments of the nearshore Port Gardner problem area. Also, some stations demonstrated relatively high concentrations of PAH and PCBs. Potential sources of contamination in the vicinity of this problem area include the Mukilteo Defense Fuel Supply Depot, the Mukilteo Wastewater Treatment Plant (WWTP), and three surface water discharge points (Japanese Gulch, Edgewater Creek, and Powder Mill Gulch). Although groundwater samples taken from monitoring wells at the Mukilteo Defense Fuel Supply Depot in 1986 were visibly contaminated with oily substances, chemical analyses detected only a few of the target compounds (a few metals and PAH compounds) at relatively low concentrations. Based on the dissimilarity of contaminants in the sediments from the problem area and groundwater from the fuel depot, a link between contaminated groundwater from the Mukilteo Defense Fuel Supply Depot and the problem chemicals identified in offshore sediments could not be demonstrated.

No data were available for characterizing surface waters discharging to the offshore Port Gardner problem area. A number of potential sources of contamination were present in the drainages of the three creeks mentioned qualified for a variety of minor reasons. A complete discussion of these qualifications is presented in Section 3.0.

CHARACTERIZATION OF ONSHORE SAMPLES

Drain Sediments

The largest number of problem chemicals (8) were found in the sample from CSO E011-2, which is located on Scott Paper Company property. All four of the drain sediment samples contained at least two problem chemicals. Chromium was a problem chemical in all four sediment samples, and nickel was a problem chemical in three of the sediment samples. Other problem chemicals identified in at least one of the drains included cadmium, zinc, DDT, acenapthene, 4-methylphenol, benzoic acid, dibenzofuran, naphthalene, acenaphthylene, dimethyl phthalate, and total low molecular weight polynuclear aromatic hydrocarbons (LPAH).

Groundwater Samples

The concentrations of chemicals found in the groundwater samples were compared to U.S. EPA water quality criteria for freshwater to provide a general, qualitative description of the quality of the groundwater collected. Concentrations of copper, lead, mercury, and silver each exceeded the chronic criteria in at least one of the groundwater samples.

SOURCE EVALUATIONS

In many cases, no specific sources of the problem chemicals found in offshore sediments could be identified because of a lack of chemical data pertaining to nearby potential sources. To more thoroughly identify specific sources of contamination, further investigation in the study area is needed. A summary of the source evaluations for each high-priority problem area and problem station is presented below.

above (e.g., abandoned landfills and dumps, and training areas for firefighting exercises in the Snohomish County Airport/Paine Field area). An Ecology field investigation of the Paine Field area was underway at the time of this writing.

Problem Station OG-01

Station OG-01 was located near the Scott Paper Company diffuser (Outfall SW001). This area was characterized by contamination from 4-methylphenol, PAH, and resin acids. These contaminants have varying degrees of association with the pulp industry. Outfall SW001 is currently used to discharge effluent from the Scott Paper Company primary clarifiers. Prior to 1980, the outfall was also used by Weyerhaeuser for the discharge of a variety of effluents, including untreated sulfite waste liquor. These discharges may have been the source of resin acids in the vicinity of Station OG-01. Sources of the 4-methylphenol and PAH have not been identified.

Problem Station SD-03

Station SD-03 was located in the Snohomish River delta offshore from a historical Western Gear outfall (WG002). Western Gear specialized in the manufacture of heavy equipment and machinery for the oil drilling industry, and discharged noncontact cooling water through Outfall WG002 prior to 1988. Sediment samples from Station SD-03 were contaminated with benzoic acid, benzyl alcohol, DDT, and 4-methylphenol. No potential sources for any of the problem chemicals have been identified. The presence of DDT in sediments from this area may be due to its historical agricultural use in the Snohomish River drainage basin.

Problem Station SR-05

Station SR-05 was located in the Snohomish River offshore of the Weyerhaeuser Kraft Mill. Sediment samples from this area were contaminated with benzoic acid, 4-methylphenol, and resin acids. Discharges from one or

Problem Station SD-01

Station SD-01 was located in the Snohomish River delta and was designated as a problem station because of benthic effects. Sediments from the area contained 12 percent gravel, less than 5 percent fine-grained material, and low concentrations of organic carbon and sulfide. No substantially elevated concentrations of chemicals were observed in the sediments from this station. Benthic effects observed in this area may have been the result of natural physical stresses, such as those caused by the swift currents observed in the area rather than chemical contamination (PTI and Tetra Tech 1988b).

1.0 INTRODUCTION

1.1 OBJECTIVES

The Everett Harbor Action Program was initiated, in cooperation with U.S. EPA, Ecology, and other resource management agencies, to identify and control toxic contamination in Port Gardner and the lower Snohomish River. A preliminary assessment of toxic problem areas, potential contaminant sources (Tetra Tech 1985b), and a review of existing plans for corrective actions (Tetra Tech 1986c) provided the framework for an analysis of potential sources of toxic contaminants in these problem areas. Results from the analyses of additional samples collected from the nearshore receiving environment are presented in PTI and Tetra Tech (1988b).

The objectives of the source evaluation are to:

- Evaluate potential sources based on contaminant concentrations measured in sediments collected from two CSOs, a storm drain, and in groundwater samples collected from three wells in October 1986

- Link potential contaminant sources to the problem areas observed in the offshore receiving environment.

The source sampling program was designed as an initial screening measure to identify the problem chemicals in a limited number of drains discharging into Port Gardner and in groundwater samples from three monitoring wells at the Mukilteo Defense Fuel Supply Depot. A more comprehensive source sampling effort will be required to adequately characterize the contributions of contaminant sources to the project area. Ranking and prioritization of sources were not performed because of the limited number of sources sampled during this investigation.

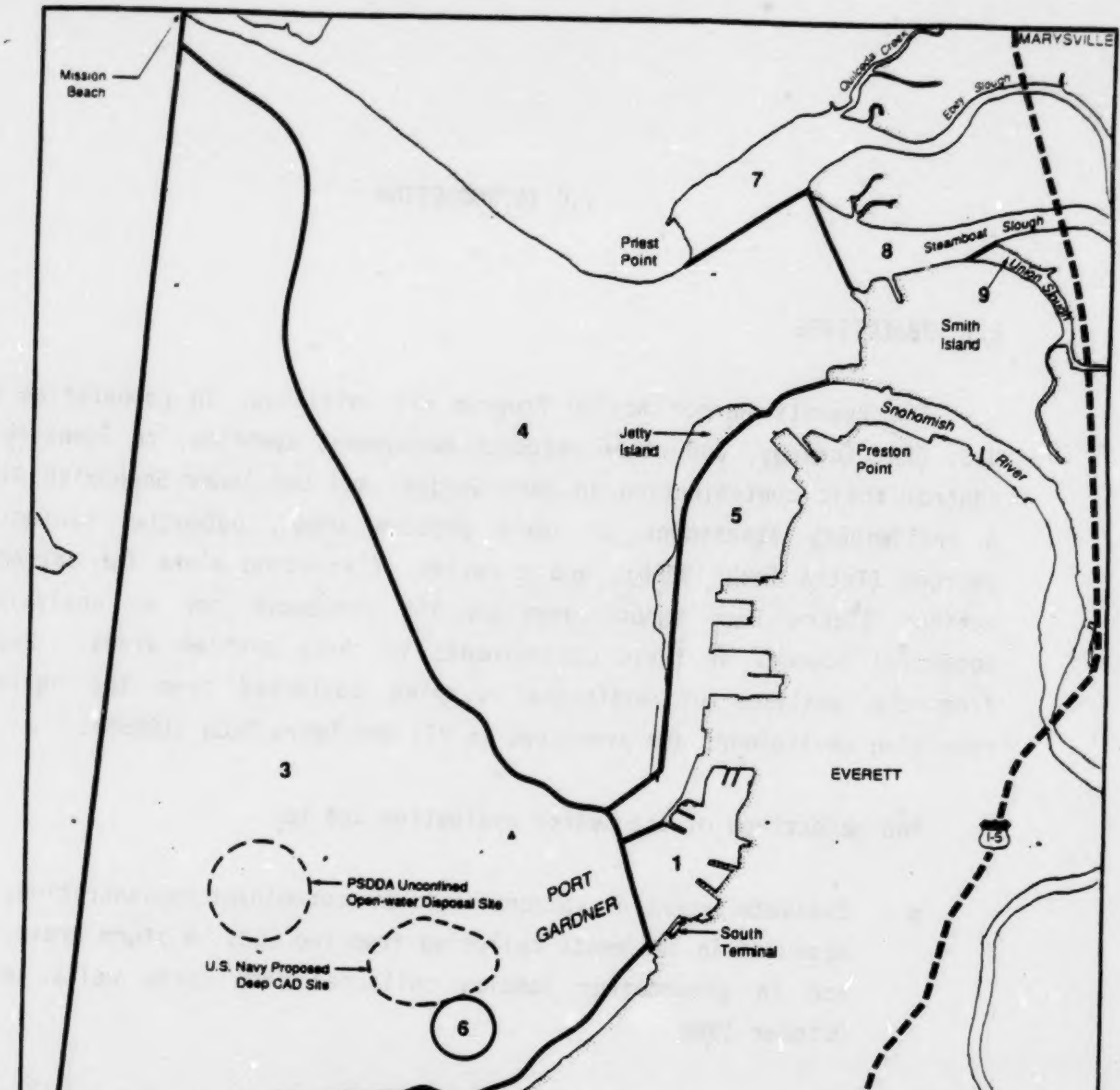
MARYSVILLE
Mission Beach
Quilceda Creek
Ebey Slough
7
Priest Point
8
Steamboat Slough
9
Union Slough
Smith Island
4
Jetty Island
Snohomish River
Preston Point
5
3
EVERETT
I-5
1
PSDDA Unconfined Open-water Disposal Site
PORT GARDNER
South Terminal
U.S. Navy Proposed Deep CAD Site
6
2
MUKILTEO
Elliott Point
WASHINGTON
LEGEND
1. EAST WATERWAY
2. NEARSHORE PORT GARDNER
3. OFFSHORE PORT GARDNER
4. SNOHOMISH RIVER DELTA
5. SNOHOMISH RIVER
6. FORMER PORT GARDNER DREDGED MATERIAL DISPOSAL SITE
7. EBEY SLOUGH
8. STEAMBOAT SLOUGH
9. UNION SLOUGH
CAD CONFINED AQUATIC DISPOSAL
PSDDA PUGET SOUND DREDGED DISPOSAL ANALYSIS
0
5000
feet
meters
0
1500

Figure 1. Project location and study areas within Everett Harbor and the lower Snohomish River.

observed as far upstream as 0.62 mi from Preston Point (PTI and Tetra Tech 1988b).

1.2.2 Study Areas

A major objective of this report is to evaluate potential sources of toxic contaminants contributing to the contamination observed in the nearshore region of Everett Harbor and the lower Snohomish River. To facilitate spatial analysis of chemical and biological data, the nearshore region (i.e., less than approximately 164-ft water depth) was divided into nine smaller areas (see Figure 1) based on geographic features and locations of potential sources of contaminants. Area boundaries and major features are as follows:

1. East Waterway (EW)--All of the East Waterway north and east of a line from the Snohomish River mouth to the southernmost boundary of the historical Weyerhaeuser Pulp Mill dock (South Terminal).

2. South (Nearshore) Port Gardner (NG)--Shoreline areas (less than or equal to a 33-ft depth) from Elliott Point (Mukilteo) to the southernmost boundary of the South Terminal including the area near the Mukilteo Defense Fuel Supply Depot.

3. Offshore Port Gardner (OG)--All deep-water (>33 ft) areas of Port Gardner exclusive of other defined areas.

4. Snohomish River Delta (SD)--The area west of a line drawn between the downstream shoreline of Ebey (approximately 0.6 mi to the east of the Everett WWTP) and Smith Islands out to the 33-ft depth contour.

5. Snohomish River (SR)--The main navigable river channel downstream from the I-5 bridge to the mouth of the river.

- Appendix C - NPDES and City of Everett industrial pretreatment permits

- Appendix D - Grain size characteristics in the sediments from the drains and offshore receiving environment

- Appendix E - Elevation of drain sediment contaminant concentrations above reference values

- Appendix F - Dredging history in the project area

- Appendix G - Puget Sound air pollution registration file listings in the project area.

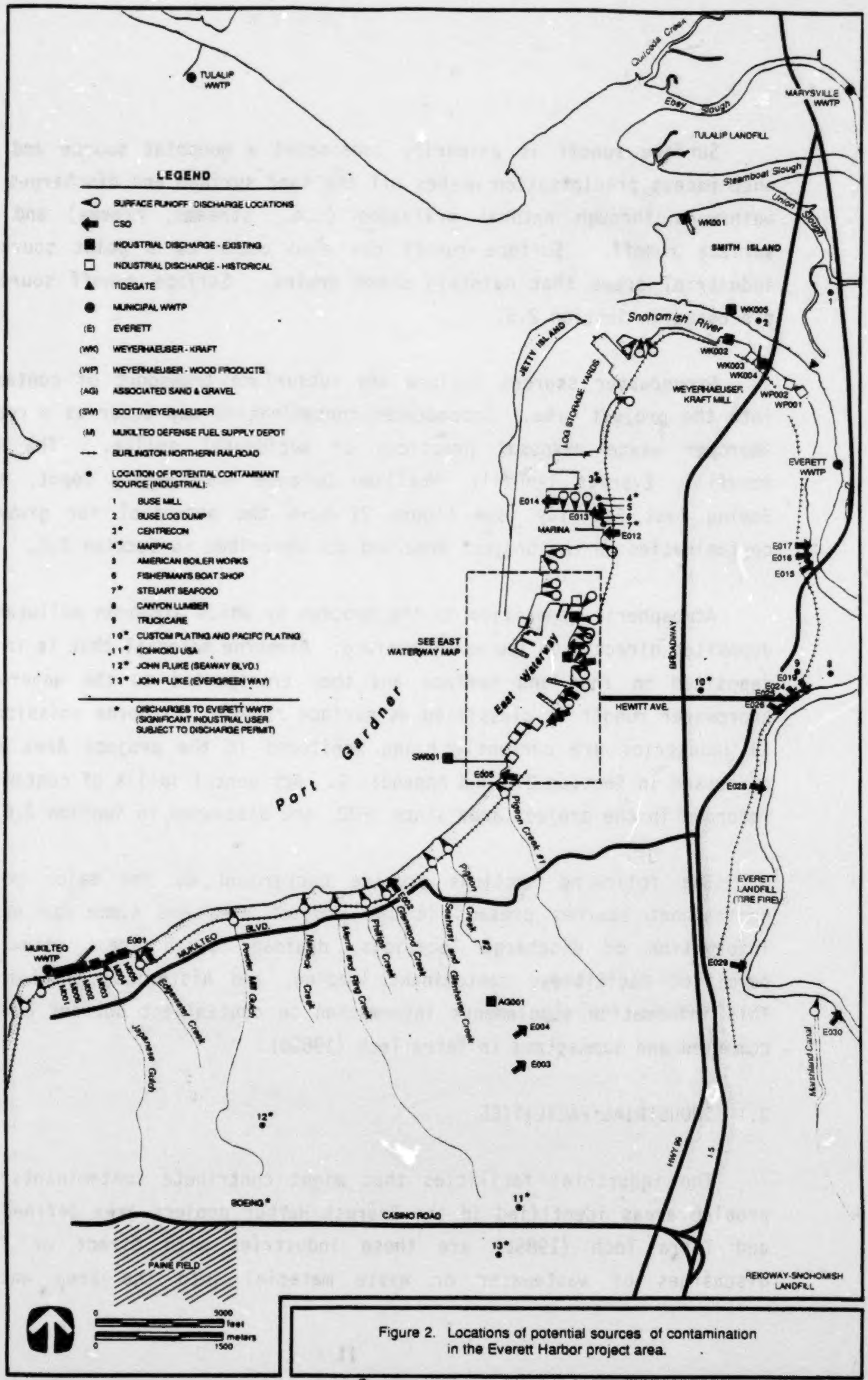
LEGEND
SURFACE RUNOFF DISCHARGE LOCATIONS
CSO
INDUSTRIAL DISCHARGE - EXISTING
INDUSTRIAL DISCHARGE - HISTORICAL
TIDEGATE
MUNICIPAL WWTP
(E) EVERETT
(WK) WEYERHAEUSER - KRAFT
(WP) WEYERHAEUSER - WOOD PRODUCTS
(AG) ASSOCIATED SAND & GRAVEL
(SW) SCOTT/WEYERHAEUSER
(M) MUKILTEO DEFENSE FUEL SUPPLY DEPOT
BURLINGTON NORTHERN RAILROAD
LOCATION OF POTENTIAL CONTAMINANT SOURCE (INDUSTRIAL):
1 BUSE MILL
2 BUSE LOG DUMP
3* CENTRECON
4* MARPAC
5 AMERICAN BOILER WORKS
6 FISHERMAN'S BOAT SHOP
7* STEUART SEAFOOD
8 CANYON LUMBER
9 TRUCKCARE
10* CUSTOM PLATING AND PACIFIC PLATING
11* KOHKOKU USA
12* JOHN FLUKE (SEAWAY BLVD.)
13* JOHN FLUKE (EVERGREEN WAY)
* DISCHARGES TO EVERETT WWTP (SIGNIFICANT INDUSTRIAL USER SUBJECT TO DISCHARGE PERMIT)
TULALIP WWTP
Quilceda Creek
Ebey Slough
MARYSVILLE WWTP
TULALIP LANDFILL
Steamboat Slough
Union Slough
WK001
SMITH ISLAND
WK005
Snohomish River
JETTY ISLAND
LOG STORAGE YARDS
WK002
WK003
WK004
WEYERHAEUSER KRAFT MILL
WP002
WP001
EVERETT WWTP
E014
E013
MARINA
E012
E017
E016
E015
SEE EAST WATERWAY MAP
East Waterway
BROADWAY
HEWITT AVE.
E018
E024
E026
SW001
E005
Port Gardner
Pigeon Creek #1
E028
EVERETT LANDFILL (TIRE FIRE)
Pigeon Creek #2
Seahurst and Glenhaven Creek
Glenwood Creek
Phillips Creek
Merrill and Ring Creek
Narbeck Creek
Powder Mill Gulch
Edgewater Creek
Japanese Gulch
MUKILTEO BLVD.
MUKILTEO WWTP
E001
M001
M002
M003
M004
M005
M006
AG001
E004
E003
E029
Marshland Canal
E030
HWY 99
I-5
BOEING
CASINO ROAD
PAINE FIELD
REXOWAY-SNOHOMISH LANDFILL
0 5000 feet
0 1500 meters

Figure 2. Locations of potential sources of contamination in the Everett Harbor project area.

Surface runoff is primarily considered a nonpoint source and occurs when excess precipitation washes off the land surface and discharges to the waterways through natural drainages (i.e., streams, creeks) and direct surface runoff. Surface runoff can also occur as a point source from industrial areas that maintain storm drains. Surface runoff sources are discussed in Section 2.5.

Groundwater sources include any subsurface transport of contaminants into the project area. Groundwater contamination may occur as a result of improper waste disposal practices or accidental spills. The Tulalip landfill, Everett landfill, Mukilteo Defense Fuel Supply Depot, and the Boeing Test Facility (see Figure 2) have the potential for groundwater contamination in the project area and are described in Section 2.6.

Atmospheric deposition is the process by which airborne pollutants are deposited directly on the water surface. Airborne material that is initially deposited on the land surface and then transported to the waterways by stormwater runoff is classified as surface runoff. Airborne emissions from 13 industries are currently being monitored in the project area and are discussed in Section 2.7 and Appendix G. Accidental spills of contaminants, recorded in the project area since 1972, are discussed in Section 2.8.

The following sections provide background on the major potential contaminant sources present in the project area and summarize available information on discharge locations, drainage basin areas, flow rates, permitted facilities, contaminant loading, and historical problem sites. This information supplements information on contaminant sources previously compiled and summarized in Tetra Tech (1985b).

2.1 INDUSTRIAL FACILITIES

The industrial facilities that might contribute contaminants to the problem areas identified in the Everett Harbor project area defined by PTI and Tetra Tech (1988b) are those industries with direct or indirect discharges of wastewater or waste material into the area waterways.

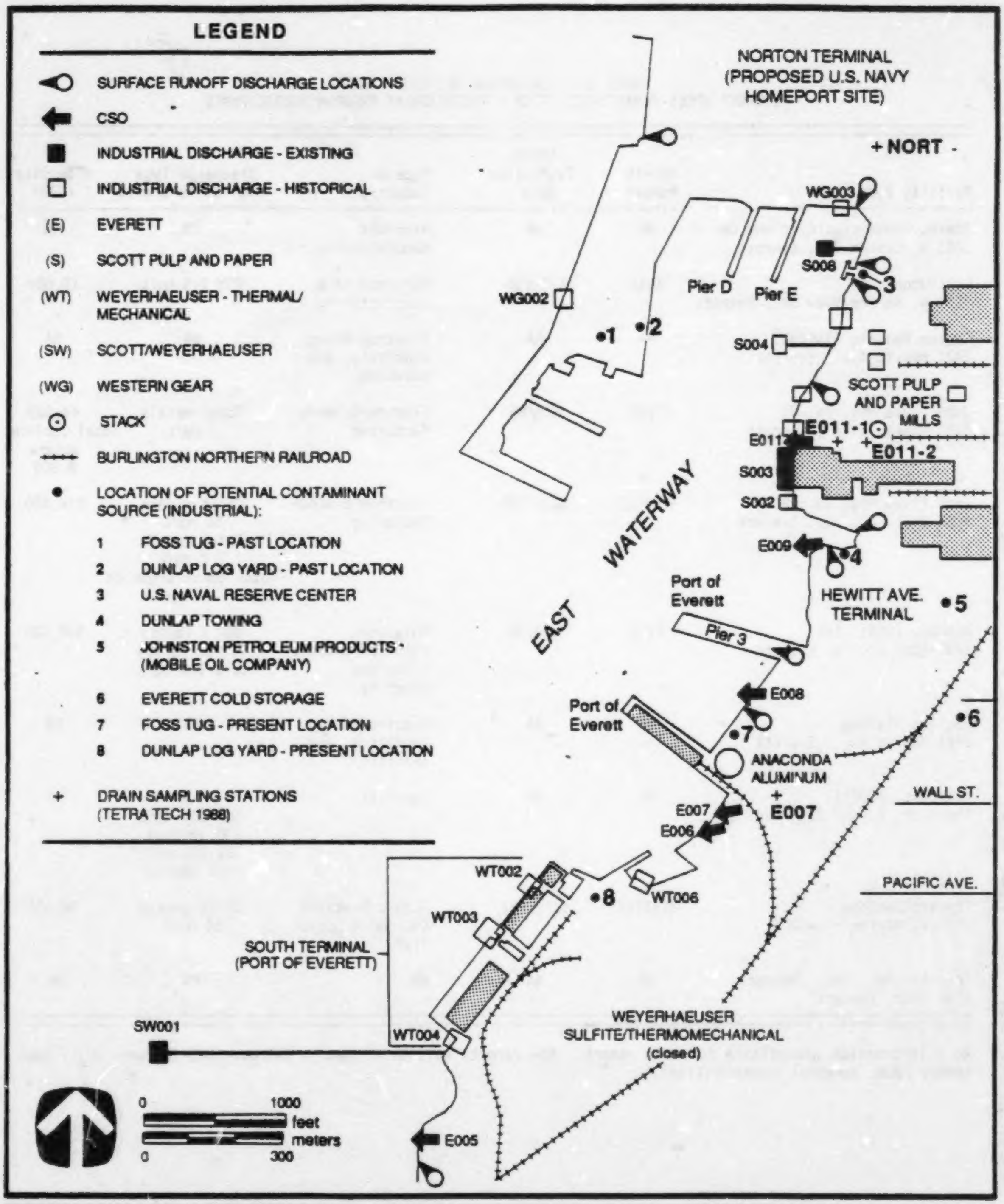
LEGEND
SURFACE RUNOFF DISCHARGE LOCATIONS
CSO
INDUSTRIAL DISCHARGE - EXISTING
INDUSTRIAL DISCHARGE - HISTORICAL
(E) EVERETT
(S) SCOTT PULP AND PAPER
(WT) WEYERHAEUSER - THERMAL/MECHANICAL
(SW) SCOTT/WEYERHAEUSER
(WG) WESTERN GEAR
STACK
BURLINGTON NORTHERN RAILROAD
LOCATION OF POTENTIAL CONTAMINANT SOURCE (INDUSTRIAL):
1 FOSS TUG - PAST LOCATION
2 DUNLAP LOG YARD - PAST LOCATION
3 U.S. NAVAL RESERVE CENTER
4 DUNLAP TOWING
5 JOHNSTON PETROLEUM PRODUCTS (MOBILE OIL COMPANY)
6 EVERETT COLD STORAGE
7 FOSS TUG - PRESENT LOCATION
8 DUNLAP LOG YARD - PRESENT LOCATION
+ DRAIN SAMPLING STATIONS (TETRA TECH 1988)
NORTON TERMINAL (PROPOSED U.S. NAVY HOMEPORT SITE)
+ NORT
WG003
S008
3
Pier D
Pier E
WG002
1
2
S004
SCOTT PULP AND PAPER MILLS
E011
E011-1
E011-2
S003
S002
EAST WATERWAY
E009
4
Port of Everett
HEWITT AVE. TERMINAL
5
Pier 3
E008
Port of Everett
6
7
ANACONDA ALUMINUM
WALL ST.
E007
E007
E006
WT002
WT006
8
PACIFIC AVE.
WT003
SOUTH TERMINAL (PORT OF EVERETT)
WEYERHAEUSER SULFITE/THERMOMECHANICAL (closed)
SW001
WT004
0 1000 feet
0 300 meters
E005

Figure 4. Locations of drain sampling stations, industrial discharge outfalls, CSOs, and storm drains in the East Waterway study area.

TABLE 2. DISCHARGES TO EVERETT WWTP
EVERETT NPDES-PERMIT FACILITIES - PRETREATMENT PROGRAM PARTICIPANTS

Facility Name	Permit Number	NPDES Expiration Date	Type of Industry	Discharge Type and Permit Limits	Flow Rate (GPD)
Boeing Commercial Airplane Co. 3003 W. Casino Rd., Everett	NA	NA	Aircraft manufacturing	NA	NA
Centrecon 1130 W. Marine View Dr., Everett	5142	8/30/90	Concrete pole manufacturing	TSS 205 mg/L	10,000
Custom Pacific Plating 2421 Hewitt Ave., Everett	NA	NA	Electroplating, anodizing, and painting	NA	NA
John Fluke Mfg. Co. #1 6920 Seaway Blvd., Everett	5183	6/8/86	Electronic manufacturing	Total metals 1 mg/L	44,000 Total cooling waters 8,900
John Fluke Mfg. Co. #2 9028 Evergreen Way, Everett	5147(I)	12/17/89	Electronic manufacturing	Oil & grease 50 mg/L Total metals 6.8 mg/L Total toxic organics 4.57 mg/L	216,800
Kohkoku (USA), Inc. 1407-80th St. SW, Everett	5175	5/31/89	Polyvinyl chloride plastic films and sheeting	BOD 7 lb/day TSS 17 lb/day Oils 100 mg/L	500,000
Pacific Plating 2421 Hewitt Ave., Everett	NA	NA	Electroplating, anodizing, and painting	NA	NA
Cathcart Landfill 109th St. SE and 39th Ave. E.	NA	NA	Landfill	NA BOD 200 mg/L (97 lb/day) TSS 250 mg/L (120 lb/day)	NA
Steuart Seafood 1520 W. Marine View Dr.	5153(I)	12/23/91	Fish processing (salmon & bottom fish)	Oil & grease 50 mg/L	58,000
Tri-Coatings, Inc. (Marpac) 1104 10th, Everett	NA	NA	NA	NA	NA

NA = Information unavailable for this report. New permits will be issued in October 1988 (Kerwin, J., 7 September 1988, personal communication).

2.1.1 East Waterway

The East Waterway problem area is located west of downtown Everett and east of the mouth of the Snohomish River channel (see Figures 2 and 4). This area, particularly along the eastern shoreline, is the most highly contaminated in the entire Everett Harbor project area. The maximum concentration of nearly every chemical measured during the receiving environment survey was found in the East Waterway (PTI and Tetra Tech 1988b). The toxic chemicals observed in East Waterway sediments included phenolic compounds, resin acids, PAHs, PCBs, and various metals. Many of the compounds observed are related to pulp industry discharges (PTI and Tetra Tech 1988b). The possible contributions from CSOs and private storm drains are discussed in Sections 2.3, 2.5, and 5.1.1 of this report.

Scott Paper Company--

The Scott Paper Company has been operating on this site on East Waterway since 1930 (see Figure 4). The company's operation extends the length of the eastern shore of East Waterway from 22nd Street south to Everett Avenue. The Scott Paper Company pulp and paper mills produce ammonia-based sulfite pulp, and towel and tissue paper. There are two auxiliary plants on the site: a steam plant and a WWTP. Figure 5 is a diagram of the water flow through the plant.

Scott is a permitted discharger of primary and secondary treatment effluent wastewater to the East Waterway, and primary treatment effluent to offshore Port Gardner. The permit information is summarized in Table 1 (see Section 2.1) (Scott Paper Company 1979). The nearshore diffuser (S003) and the secondary treatment plant outfall (S008) discharge into the mouth and head, respectively, of the East Waterway. The deepwater diffuser (SW001) discharges primary treatment effluent through an outfall 2,000 ft offshore. This outfall is discussed later in this section. Scott's NPDES permit, WA 000062-1, specifies monitoring and reporting of biochemical oxygen demand (BOD), total suspended solids (TSS), total flow (Q), and total production of air-dried bleached pulp product on a daily basis (Scott Paper Company 1979). Priority-pollutant data available from the permit application and the

U.S. EPA's STORET database are presented in Tetra Tech (1985b). Discharge monitoring report worksheets provide a breakdown of total flow, BOD, and TSS by individual outfall. The worksheet information for 1985 through April 1988 is summarized in Tables 4, 5, and 6.

The wastewater flow to each outfall is determined by individual plant processes and is shown Figure 5 (Scott Paper Company 1979). Effluent from the two primary clarifiers is combined and discharged from Outfalls SW001 and S003 without further treatment. This discharge is separated at a weir under the pulp mill. Ideally, the flow to Outfall SW001 is maximized and Outfall S003 is used primarily as an overflow outfall. In practice, the flows to each outfall are separated such that the pH at Outfall S003 is maintained at permitted levels. Approximately one-half of the effluent is directed to each outfall. The clarifiers process water from the hog fuel boiler in the steam plant, water from three sumps used for fiber collection in the pulp mill, a continuous flow of machine sewer water, an intermittent flow of water from the color-change line in the paper mill, and backwash from the fresh water filters. This backwash is comprised of grit and other material that has been filtered from incoming unprocessed city water (Bechtel, T., 1 July 1988, personal communication).

The remainder of the wastewater from all of the processes is routed to the Scott industrial WWTP. Effluent from the treatment plant is discharged at Outfall S008. The Scott WWTP is designed to collect waste from streams with a high BOD content. The treatment plant processes wastewater from the spent sulfite liquor system, the acidified water used to regenerate the resins in the water deionizing columns, wastewater (brown "white water") from the pulp mill, sludge dewatering filtrate, bleach plant waste, and wastewater from the paper mill "bayline" floor trenches. Water from the floor trenches was formerly discharged at Outfall S004. Prior to construction of the WWTP in 1980, untreated pulp bleaching wastewater effluent was discharged through Outfall S002, south of Outfall S003 (see Figure 4). The Scott pulp mill currently unloads liquid chlorine (pressurized chlorine gas) for its pulp bleaching process near the historic Outfall S002 (Bechtel, T., 1 July 1988, personal communication). The SW001 Outfall discharges into the offshore Port Gardner area and is discussed below.

TABLE 4. (Continued)

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1987					
J	8.2	62	4,257	70	4,816
F	8.0	79	5,293	89	5,991
M	7.9	76	5,016	77	5,093
A	8.0	63	4,199	70	4,662
M	7.7	59	3,777	65	4,128
J	7.7	49	3,182	52	3,333
J	6.9	46	2,660	51	2,911
A	6.3	45	2,361	49	2,580
S	6.4	50	2,698	53	2,821
O	8.1	57	3,828	63	4,225
N	7.7	61	3,901	58	3,732
D	8.2	65	4,492	65	4,505
Total	2,727 MG		684 ton		730 ton
1988					
J	8.0	69	4,631	70	4,723
F	5.8	65	3,142	54	2,583
M	5.7	70	3,379	57	2,660
A	6.5	65	3,527	69	3,707
Total	752		212		198
3-1/3 Yr Average	7.9 ±1.1[a]	70 ±15	4,661 ±1,460	71 ±16	4,717 ±1,500

[a] Average = $\bar{x} \pm$ SD (SD = standard deviation).

Reference: Scott Paper Company (1988).

TABLE 5. (Continued)

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1987					
J	5.0	84	3,416	52	2,214
F	7.6	71	4,596	61	4,040
M	5.0	78	3,070	55	2,358
A	7.0	56	3,214	43	2,584
M	7.2	48	2,931	33	2,004
J	7.1	44	2,602	34	2,004
J	6.1	69	3,328	49	2,343
A	6.7	41	2,285	27	1,489
S	7.8	42	2,816	41	2,787
O	8.0	57	3,719	46	3,105
N	4.7	63	2,366	39	1,611
D	5.1	77	3,158	47	2,040
Total	2,330 MG		566 ton		430 ton
1988					
J	6.8	88	5,414	61	3,630
F	4.4	89	3,271	46	1,688
M	7.0	132	6,970	53	3,165
A	5.0	162	6,382	60	2,563
Total	706 MG		335 ton		168 ton
3-1/3 yr Average	6.0 ±1.5[a]	67 ±29	3,159 ±1,296	47 ±13	2,364 ±832

[a] Average = $\bar{x} \pm$ SD (SD = standard deviation).

Reference: Scott Paper Company (1988).

TABLE 6. (Continued)

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1987					
J	14.4	18	2,174	54	6,433
F	13.1	15	1,665	38	4,186
M	15.3	14	1,775	44	5,698
A	14.2	18	2,169	42	4,906
M	13.9	16	1,846	37	4,387
J	14.2	21	2,389	51	5,939
J	15.6	23	2,526	50	5,793
A	19.1	28	4,387	53	8,297
S	15.8	32	4,430	58	7,748
O	15.9	28	3,794	63	8,354
N	17.1	23	3,264	57	8,103
D	16.5	19	2,608	39	5,419
Total	5,610 MG		501 ton		1,141 ton
1988					
J	15.2	21	2,675	55	6,582
F	19.6	16	2,708	48	7,905
M	13.9	22	2,791	63	7,826
A	17.9	17	2,524	43	6,248
Total	1,985 MG		162 ton		432 ton
3-1/3 yr Average	14.1 ±2.4[a]	24 ±6	2,812 ±686	58 ±14	6,747 ±1,447

[a] Average = $\bar{x}$ ± SD (SD = standard deviation).

Reference: Scott Paper Company (1988).

TABLE 7. ORGANIC CHEMICALS AND METALS FOUND IN SCOTT PULP AND PAPER MILL OUTFALLS (mg/L)

Contaminant	Date of Sample	Outfall SW001	Outfall S003	Outfall S008	
				Influent	Effluent
Metals					
Cadmium	6/5/85[a]	0.0010	0.0010	NA	0.0020
	10/1/86[b]	0.0016	0.0007	NA	0.0017[c]
Chromium	6/5/85[a]	0.0050	0.0050	NA	0.0100
	10/1/86[b]	ND	ND	NA	ND
Copper	6/5/85[a]	0.0040	ND	NA	0.0020
	10/1/86[b]	ND	ND	NA	ND
Nickel	6/5/85[a]	ND	ND	NA	0.0070
	10/1/86[b]	0.005	0.008	NA	ND
Silver	6/5/85[a]	ND	ND	NA	0.0018
	10/1/86[b]	ND	ND	NA	ND
Zinc	6/5/85[a]	0.0450	0.0170	NA	0.440
	10/1/86[b]	0.082	0.033	NA	0.073[c]
Volatile Organics					
Acetone	10/1/86[b]	0.200	0.130	NA	0.015
Chloroform	7/9/85[d]	NA	NA	NA	0.049
	11/24/82[d]	0.107	NA	NA	
	9/22/82[d]	NA	0.373	NA	1.130
	10/1/86[b]	0.079	0.035	NA	0.066
Ethyl benzene	11/24/82[d]	0.021	NA	NA	
Carbon Tetrachloride	9/22/82[d]	NA	NA	NA	0.010
Semivolatile Organics					
Benzoic acid	10/1/86[b]	0.057	ND	NA	ND
Resin Acids					
Isopimaric[e]	NA	NA	NA	0.140	ND
Isopimaric[f]	3/2/83	NA	NA	0.285	ND
Dehydroabietic[e]	NA	NA	0.035	0.852	0.002
Dehydroabietic[f]	3/2/83	NA	NA	1.463	0.018
Abietic[e]	NA	NA	0.004	0.010	ND
Retene[f]	3/2/83	NA	NA	0.0009	0.045

[a] Bechtel, T. (19 July 1985, personal communication).

[b] Kjosness, D. (1 August 1988, personal communication).

[c] This value is the average result from two duplicate analyses.

[d] Bailey, A. (7 November 1985, personal communication).

[e] Archer, S. (9 September 1983, personal communication).

[f] Johnson, B. (9 August 1983, personal communication).

ND = Not detected.

NA = Information not available.

criteria for marine water (0.0029 mg/L) in June 1985. Other metals did not exceed the criteria, but the nickel concentration (0.0070 mg/L) was close to the chronic effects limit of 0.0083 mg/L. These criteria provide a general, qualitative description of water quality and may differ from the criteria specified in the discharge permit.

2.1.3 Nearshore Port Gardner

The Nearshore Port Gardner problem area includes nearly all of the NG stations and is located in the southwest corner of the project area (Figure 6). Potential industrial sources of contamination in this area are the Mukilteo Defense Fuel Supply Depot and the various industries in the Boeing/Paine Field area (Figure 6). Wastes from this area collect in the streams and gullies that flow into Port Gardner. Other potential contaminant sources, including the Mukilteo WWTP and general surface runoff, are described in Sections 2.2 and 2.5.

Mukilteo Defense Fuel Supply Depot--

The Mukilteo Defense Fuel Supply Depot receives, stores, and transfers aviation gasoline and aviation turbine fuel (JP-4) (Tetra Tech 1985b). The facility consists of a transfer pier, a railroad tank car loading area, a fuel laboratory, and ten bulk fuel storage tanks. . There are six outfalls from the fuel storage tank area that discharge directly into Port Gardner. Outfalls M001 through M005 are for storm water and fuel condensate, and Outfall M006 discharges storm water and wastewater from the fuels laboratory. These discharges are permitted under Ecology NPDES Permit No. WA 002523-2, and are monitored for oil and grease on a monthly basis (see Table 1). Outfall M006 is also monitored for flow. Discharge monitoring report data for this facility were not available for this report.

There have been two major leakages at the fuel storage facility; the first leakage occurred in 1982 and the second in 1986. In 1982, Tank 10 was found to have structural and seepage problems. In 1982 and 1983, groundwater studies were conducted at the Tank 10 site by the U.S. Army Environmental Hygiene Agency (AEHA) to determine if contamination had resulted from suspected storage tank leakage. Results of these studies are described in

Tetra Tech (1985b). Tank 10 was drained prior to the AEHA study and is no longer in use. Samples taken in 1983 from monitoring wells near Tanks 9 and 10 contained JP-4 fuel in excess of 1,000 ppm and all other wells in the vicinity contained less than 10 ppb of benzene, ethylbenzene, toluene, or chloroform (Spencer and Rodgers 1987). A memo from the Snohomish County Environmental Health Office's files, dated 29 June 1987, contains data on the detection of HPAH (e.g., benzopyrenes, benzoanthracene, benzofluoranthene, chrysene) at the facility.

In 1986, leakage problems were discovered at Tank 9. A hydrogeologic survey was conducted to determine the effects on the groundwater of fuel leakage in the piping to Tank 9 and to propose remediation plans. The conclusions of this survey state that a substantial amount of JP-4 fuel is on the groundwater surface near Tank 9, but the more volatile additives to JP-4 fuel (benzene, toluene, and xylene) are not retained in the groundwater for any significant amount of time. The survey also concludes that leaching of residual concentrations of hydrocarbons into Puget Sound is the only path of environmental exposure (Spencer and Rodgers 1987).

Boeing/Paine Field and Related Industries--

The area south of the nearshore Port Gardner problem area and Mukilteo (see Figure 2) contains the Snohomish County Airport (Paine Field), several large industries, an automobile racing track, and unpermitted landfills. These sources may contribute to the contamination of surface water, groundwater, and the sewer system. Such contaminants could be transported to Port Gardner through Japanese Gulch and Powder Mill Gulch.

Information in the files at the Snohomish County Environmental Health Department describe several contamination problems in the Paine Field area. There is a long history of nonpermitted landfill sites at the western and southern ends of the airport, including an old Air Force dump. Poor hazardous waste storage practices at numerous places in and around the airport area were also documented in county inspection reports (Winters, T., 16 January 1987, personal communication). There is concern that leachate from the landfills, dumping, and hazardous waste spills may enter the

TABLE 8. PAINE FIELD SEDIMENT CHEMICAL DATA

Sample Location	Units	Acetone	1,1-Dichloroethane	Trans-1,2-chloroethane	Chloroform	1,1,1-Trichloroethane	Trichloroethene	PCB 1254
Suspended sediment Boeing pond[a] 09/02/87	mg/L				0.0015			
Powder Mill Gulch Retention (Boeing) pond[b] 08/11/87	mg/kg							20.5
Suspended sediment Drain at 100th Street SW[a] 09/03/87	mg/L	0.036	0.0056	0.0011	0.0031	0.056	0.028	
Drain at 100st Street SW[b] 08/10/87	mg/kg							0.084
Japanese pond[b] 08/11/87	mg/kg							0.28
Powder Mill Gulch mouth[b] 8/10/87	mg/kg							0.044

[a] Analytical Resources Inc. (1987).

[b] Carrell, B. (24 March 1987, personal communication).

TABLE 9. JOHN FLUKE MFG. CO., INC. - EVERGREEN WAY PLANT
RESULTS FROM CHEMICAL ANALYSIS OF PROCESS WASTEWATER

	Concentrations in mg/L						
	Date of Sample						
Metal	2/2/88	2/10/88	2/18/88	2/26/88	Daily Limit	Monthly Average	Monthly Average Limit
Copper	0.0034	0.0037	0.0016	0.0013	0.00338	0.0025 ±0.0012	0.00207
Nickel	0.00032	0.00039	0.00048	0.00023	0.00398	0.00036 ±0.00011	0.00238
Chromium	<0.00005	<0.00005	<0.00005	<0.00005	0.00277	<0.00005	0.00171
Zinc	0.00004	0.00004	0.00007	0.00009	0.00261	0.00006 ±0.00002	0.00148
Lead	0.00077	0.00077	0.00022	0.00017	0.00069	0.00048 ±0.00033	0.00043
Cadmium	<0.00001	<0.00001	<0.00001	<0.00001	0.00069	<0.00001	0.00026
Total metals	0.0038	0.0042	0.0022	0.0017	0.0105	NA	NA

NA = Information not available.

Reference: Dawson, L. (15 March 1988, personal communication).

TABLE 10. WEYERHAEUSER KRAFT MILL EFFLUENT DISCHARGE MONITORING REPORTS (1985-APRIL 1988)[a]

		Outfall WK001		Outfalls WK001 & WK004	
	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)
1985					
J	21.8	29.0	5,300	30	5,500
F	18.2	44.8	6,900	30	4,700
M	16.3	21.3	2,900	18.3	2,600
A	16.7	21.9	3,100	24.9	2,900
M	20.0	21.8	3,600	17.8	4,000
J	19.4	25.3	4,100	28.2	4,900
J	24.8	13.1	2,700	16.5	3,500
A	24.0	17.4	3,500	21.1	4,300
S	23.7	26.7	5,300	25.7	5,100
O	20.0	18.3	3,100	26.2	4,500
N	18.6	27.4	4,100	23.7	3,900
D	19.3	31.6	4,900	25.5	4,200
Total	7,394 MG		749 ton		761 ton
1986					
J	20.9	25	4,300	31.9	5,600
F	19.1	40.0	6,400	38.7	6,400
M	19.2	29.3	4,700	27.6	4,600
A	21.6	18.2	3,300	15.9	2,900
M	25.5	22.0	4,100	21.7	4,100
J	20.8	23.6	4,100	30.4	5,300
J	20.8	29.6	5,300	41.3	7,700
A	37.2	32.4	5,500	39.7	7,000
S	12.9	18.0	2,300	22.5	3,100
O	19.7	22.6	3,800	24.9	4,200
N	18.6	22.0	3,400	27.9	4,800
D	18.9	21.8	3,400	27.1	2,800
Total	8,548 MG		768 ton		889 ton

There are very few additional data available from contaminant studies conducted at the Weyerhaeuser Kraft Mill. The NPDES permit application and data from three effluent samples provided by the Weyerhaeuser Company provide limited information on pollutant concentrations (Table 11). These data represent isolated examples from the plant effluent and are not adequate to provide a comprehensive analysis. The NPDES permit application reported values for some metals, none of which exceeded the U.S. EPA water quality criteria. Chlorobenzene was the only organic compound found in concentrations greater than the analytical detection limit (Weyerhaeuser 1983). In another sample, collected 1 April 1986, only chloroform was detected (Ruppert, H., 20 May 1988, personal communication). Acetone and chloroform were the only volatile organic compounds detected in an effluent sample from Outfall WK001 collected in October 1986 (Kjosness, D., 1 August 1988, personal communication). Data for metals found in effluent from Outfall WK001 are also presented in Table 11.

Evaluation of these data suggests that the plant is occasionally discharging elevated concentrations of certain organic compounds and metals (e.g., chlorobenzene, chloroform, magnesium, chromium, copper) (Weyerhaeuser 1983; Ruppert, H., 20 May 1988, personal communication). At various times, concentrations of chromium, copper, lead, mercury, and nickel in the effluent from Outfall WK001 have exceeded U.S. EPA saltwater criteria for chronic or acute toxicity (Table 11 and also see Table 39 in Section 3.0). These criteria provide a general, qualitative description of water quality and may differ from the limits specified in the discharge permit. Vanillin black liquor (VBL) used by the Weyerhaeuser Kraft Mill in its processes could be a source of copper. The amount of copper in the mill's effluent due to VBL is reported to be much smaller now than in the past (Ruppert, H., 12 May 1988, personal communication), and the concentrations of copper listed in Table 11 for effluent from Outfall WK001 decrease with time.

The majority of the Weyerhaeuser Kraft Mill wastewater is routed to a lagoon treatment system on Smith Island. Effluent from this system is discharged at Outfall WK001 into Steamboat Slough. This effluent is sampled for organic compounds and metals more frequently than effluent from the other outfalls. There are very few data available on the effluent discharged at Outfalls WK002, WK004, and WK005.

Everett Marina and Related Industries--

The Everett Marina is located north of the East Waterway and the Norton Terminal, across the Snohomish River channel from Jetty Island (see Figure 2). It is the second largest marina on the West Coast and contains more than 2,000 boat slips. There are facilities for both pleasure craft and commercial fishing vessels. The activities in the marina area, such as boat sandblasting and painting, are potential sources of contamination. Other possible sources of contamination in the marina, such as surface runoff and CSOs, are discussed in other sections of this report.

The location of the boat basin off the Snohomish River places the marina in a position to accumulate contaminated materials. A study conducted for the Port of Everett (Spadaro, P., 6 May 1986, personal communication) found high molecular weight polycyclic aromatic hydrocarbons (HPAH) and heavy metals in the sediments along the north end of the marina boat basin (Figure 7). A sample taken upstream of the marina in the Snohomish River near Jetty Island at historical Station SSB1 (Spadaro, P., 6 May 1986, personal communication) showed acceptable levels of chemicals similar to those found at acceptable levels in the marina. The criteria used to determine acceptability were the Interim Decision Criteria for Disposal of Dredged Material at the Port Gardner Open Water Disposal Site (Spadaro, P., 6 May 1986, personal communication). A summary of the relevant data from this study (Spadaro, P., 6 May 1986, personal communication) is provided in Table 12. HPAH concentrations were above the acceptable IDC limits at historical Stations SSB2 and SSB6. Elevated concentrations mercury were found in sediments from historical Stations SSB3 and SSB6. Elevated concentrations of arsenic, copper, lead, and zinc were found at Station SSB6. Mercury also exceeded the low AET criteria (Tetra Tech 1986g) at Station SSB6.

Nearby industries that could be sources of chemical contaminants in the Everett Marina area include boat building and repair facilities, the Marina Village, Steuart Seafoods, and other nonharbor-related businesses such as American Boiler Works, Tri-Coatings (Marpac), and Centrecon. Steuart Seafoods, Tri-Coatings, and Centrecon participate in the Everett pretreatment

TABLE 12. HISTORICAL STATIONS IN THE EVERETT MARINA WHERE POLLUTANT CONCENTRATIONS ARE ABOVE ACCEPTABLE CRITERIA

	Stations				
Contaminant	SSB2 (mg/kg)	SSB3 (mg/kg)	SSB6 (mg/kg)	IDC[a] (mg/kg)	Puget Sound[b] Low AET (mg/kg)
Arsenic	7.8	11	29	12.5	85
Copper	47	59	110	68.0	310
Mercury	0.1	0.2	0.6	0.15	0.41
Lead	<10	11	45	33	300
Zinc	61	85	160	105	260
HPAH[c]	2.720	4.811	4.740	2.690	12.000

[a] Interim Decision Criteria for Disposal of Dredged Material at the Port Gardner Open Water Disposal Site, U.S. Environmental Protection Agency, 12 February 1986.

[b] Tetra Tech (1986).

[c] Summation of benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, pyrene, and benzo(a)anthracene.

Reference: Adapted from Spadaro, P. (6 May 1986, personal communication).

TABLE 13. METALS CONCENTRATIONS IN SOIL SAMPLES FROM FISHERMAN'S BOAT SHOP, EVERETT MARINA

	Soil Sample (mg/kg)				AET[a] Low/High (mg/kg)
Contaminant	1	2	3	4	
Arsenic	480	590	720	1,370	85/700
Barium	315	435	666	142	
Cadmium	42	6	40	56	5.8/9.6
Chromium	130	71	131	114	27/59
Copper	4,950	4,380	4,610	4,540	310/800
Lead	2,520	1,190	2,330	2,660	300/700
Nickel	53	22	48	29	28/49
Silver	13	23	13	38	5.2/5.2
Zinc	8,880	7,140	9,550	28,600	260/1600
Selenium	0.8	0.1U	0.1	0.3	
Mercury	2.0	0.83	0.96	0.02	0.41/2.1

[a] Tetra Tech (1986g).

Reference: U.S. EPA Region X Lab Management System (1987).

of the samples. These data suggest that the areas in and around wood treatment facilities are potential sources of chlorinated phenolic compounds in the Everett Harbor area.

Electroplating Industries---

Pacific Plating and Custom Pacific Plating are located at the same address on Hewitt Avenue in Everett. Both companies participate in the Everett pretreatment program dischargers and are listed in Table 2 (see Section 2.1.1). Information in Ecology files pertaining to inspections of Pacific Plating and Custom Pacific Plating indicate that the potential exists for spills of toxic chemicals into the sanitary sewer system. Toxic chemicals at Pacific Plating that may be involved in such spills, include waste chromic acid, trichloroethylene, cadmium cyanide, zinc cyanide, copper cyanide, zinc oxide, nitric acid, and hydrochloric acid. Custom Pacific Plating generates cyanide, chromium, and nickel sludge. Further information is not available about suspected problems at these electroplating industries.

2.1.5 Ebey Slough

The main industrial facility in this area is the Boeing Test Facility. Its proximity to Quilceda Creek, which drains into Ebey Slough, and its current listing in CERCLIS (see Table 3) makes this facility a possible source of leachate contamination. Little additional information is available concerning possible industrial sources of contaminants in the Marysville area that could impact Ebey Slough.

The Boeing Test Facility--

The Boeing Test Facility is located on a 360-ac section of land at the eastern end of the Tulalip Indian Reservation. Boeing has operated the site since the 1950s as a fuel storage and testing area. The fuels stored here are reported to include hydrazine, peroxide, fluoride, JP-4 fuel, and PCB's (Tetra Tech 1985b). The Esperance sand aquifer beneath the site, where the watertable is at 4-5 ft, might receive leaks and spills from the test facility and provide a link to the drainage system, thereby contributing to

TABLE 15. MUKILTEO WWTP DISCHARGE MONITORING REPORTS (FEBRUARY 1987-APRIL 1988)

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)	Fecal[a] (#/100 mL)
Permit Requirements		165	300	150	280	700
1987						
J	b	b	b	b	b	b
F	1.8	191	293	87	144	333
M	1.7	203	294	131	192	186
A	1.4	241	261	77	83	146
M	1.4	289	322	77	84	150
J	1.2	257	282	228	270	417
J	b	b	b	b	b	b
A	1.2	354	333	100	96	467
S	1.7	335	292	117	101	1,669
O	1.1	315	276	55	51	957
N	1.2	355	316	83	71	113
D	1.6	254	308	109	144	363
Total	430 MG		45 ton		19 ton	
1988						
J	1.4	342	456	140	159	214
F	1.3	380	402	140	146	246
M	1.4	356	382	151	162	838
A	1.5	377	449	123	150	487
Total	170 MG		25 ton		9 ton	
Average	1.4±0.2[c]	304±64	333±64	116±43	132±57	470±427

[a] Fecal = Fecal coliform bacteria.

[b] Information not submitted for this report.

[c] Average = $\bar{x} \pm$ SD (SD = standard deviation).

TABLE 16. MARYSVILLE WWTP DISCHARGE MONITORING REPORTS (1986-MARCH 1988)

	Q (MGD)	BOD (mg/L)	BOD (lb/day)	TSS (mg/L)	TSS (lb/day)	Fecal[a] (#/100 mL)
Permit Requirements	1.2	30	300	75	751	200
1986						
J	2.4	35	290	36	320	760
F	2.7	31	259	40	330	420
M	2.0	25	208	24	200	130
A	2.1	26	218	32	266	130
M	2.3	35	291	32	266	150
J	b	b	b	b	b	b
J	1.3	50	542	62	670	130
A	1.1	50	460	125	1,250	200
S	2.3	b	490	b	642	76
O	1.5	b	650	b	600	180
N	2.0	48	760	40	635	620
D	1.9	32	507	32	507	311
Total	580 MG		71 ton		87 ton	
J	b	b	b	b	b	b
F	2.1	38	665	46	805	420
M	2.2	36	660	47	862	330
A	b	b	b	b	b	b
M	1.9	44	700	67	1,117	26
J	1.3	28	440	46	500	22
J	1.3	38	954	75	813	290
A	1.3	72	780	60	650	508
S	1.5	70	875	84	1,050	20
O	1.1	65	596	35	320	36
N	b	b	b	b	b	b
D	1.6	31	410	40	334	200
Total	430 MG		92 ton		98 ton	

aerators and three grinders to improve plant performance (Olsen, G., 20 May 1988, personal communication).

2.2.3 Everett WWTP

The Everett WWTP was built in 1960 and is located east of the Snohomish River on Smith Island. The plant is subject to frequent hydraulic and organic overloading and is approaching maximum capacity (Determan 1987). The plant consists of a headworks, two 15-ac aeration ponds, two facultative stabilization ponds, and a 2-ac chlorine contact pond. The plant effluent flows from the chlorine contact pond through a 48-in line that discharges within a few feet of the surface near the east bank of the Snohomish River (see Figure 2). The outfall has no diffuser. Minimal dilution, estimated to be about 2.5:1, has been found at the point of discharge (Determan 1987). A flapper gate at the end of the outfall is designed to minimize discharge during peak tidal flows, but it does not operate properly. Incomplete closure of the gate allows effluent material to be carried both upstream and downstream from the outfall by tidal action. Alternative discharge methods and configurations are currently under consideration (Determan 1987).

The plant effluent is monitored daily for dissolved oxygen (DO), BOD, TSS, pH, fecal coliform bacteria and fecal streptococci bacteria according the requirements of their NPDES Permit No. WA 002449-0. Heavy metals, including chromium (total and hexavalent), copper, and zinc, are monitored bimonthly. Monitoring data for May 1987 through April 1988 are given in Table 17 (effluent variables) and for April 1987 through April 1988 in Table 18 (heavy metals) (City of Everett 1988).

Both an Ecology water quality study (Determan 1987) and Class II inspection (Reif 1987) were reported by Determan in 1987. These studies assessed the characteristics of the effluent from the Everett plant and the sediments and receiving waters nearby. Dye studies were conducted to track the effluent discharge in the Snohomish River estuary. Chlorination practices were examined, and regulated discharge variables and metals concentrations in receiving water and sediment samples were studied. The results of the Ecology water quality study suggest that the flow of the

TABLE 18. EVERETT WWTP DISCHARGE MONITORING REPORTS (APRIL 1987-APRIL 1988) FOR HEAVY METALS

	Total Chromium		Copper		Zinc		Lead	
	(lb/day)	(mg/L)	(lb/day)	(mg/L)	(lb/day)	(mg/L)	(lb/day)	(mg/L)
Permit Requirements	8.8	0.1	2.65	0.03	37.1	0.42	8.8	0.1
1987								
4/3-4/30	0.27	0.0021	0.99	0.010	10.95	0.111	0.20	0.002
5/1-5/28	0.33	0.0037	1.92	0.018	5.97	0.056	1.49	0.014
5/29-6/25	0.47	0.0048	5.24	0.054	6.11	0.063	0.19	0.002
7/31-9/3	0.72	0.0072	1.80	0.018	4.68	0.047	0.40	0.004
7/31-9/4	0.66	0.0058	1.11	0.011	2.17	0.019	0.40	0.004
10/2-10/29	0.34	0.004	0.55	0.006	2.29	0.027	0.68	0.008
10/30-11/26	0.62	0.0063	1.46	0.015	4.0	0.041	0.7	0.008
11/27-12/31	1.33	0.0055	6.77	0.028	11.45	0.084	0.48	0.002
1988								
1/1-1/28	0.53	0.0055	2.87	0.030	5.27	0.055	0.57	0.006
1/29-2/25	0.42	0.0037	2.47	0.022	10.7	0.098	0.79	0.007
2/26-3/31	0.294	0.0028	3.16	0.031	11.3	0.111	0.509	0.005
4/1-4/28	1.5	0.0100	1.68	0.01	2.6	0.02	0.56	0.004
Average	0.6±0.4[a]	0.005±0.002	2.50±1.83	0.02±0.01	6.5±3.7	0.06±0.03	0.6±0.3	0.006±0.004

[a] Average = $\bar{x} \pm$ SD (SD = standard deviation).

TABLE 19. CALCULATED UP-FLOW AND PREDICTED THEORETICAL DOWN-FLOW CONCENTRATIONS OF METALS IN THE EFFLUENT DOWNSTREAM FROM THE EVERETT WWTP DILUTION ZONE COMPARED TO OTHER STUDIES AND U.S. EPA CRITERIA

Metal	Determan 13 August 1986 Up-flow (mg/L)	Determan 13 August 1986 Down-flow (mg/L)	Reif (1987) (mg/L)	Singleton, et. al (1982) (mg/L)	U.S. EPA (1987) Chronic/Acute Saltwater Criteria (mg/L)
Copper	<0.001	<0.005	0.014	0.0027	0.0029/0.0029[a]
Zinc	<0.001	0.012	0.039	0.033	0.086/0.095[b]
Nickel	<0.001	0.006	0.020	0.004	0.0083/0.075[b]
Total Chromium	<0.001	0.001	<0.001	0.078	0.050/1.100[c]
Cadmium	0.0003	0.005	0.001	<0.001	0.0093/0.043[c]
Lead	<0.001	0.006	0.020	0.008	0.0056/0.140[c]
Mercury	<0.00004	<0.00004	<0.00005	<0.0002	0.000025/0.0021[c]
Silver	0.0002	0.0003	0.0011	0.002	--/0.0023[d]

[a] 1-hr average (not to be exceeded more than once in 3 yr).

[b] 24-hr average (maximum allowable at any time).

[c] 4-day average or 1-hr average (not to be exceeded more than once in 3 yr).

[d] Maximum allowable at any time.

Reference: Adapted from Determan (1987).

of gravity sewers, pump stations, regulators, and force mains was constructed in the 1960s to intercept most of these outfalls and convey the sewage to treatment lagoons. Currently, within Everett's NESS there are 16 outfalls (2 of which are deactivated), 37 regulators, and 10 lift stations (see Figures 3 and 8).

In 1987, Ecology adopted CSO control regulations under the Washington Administrative Code (WAC 173-245), that defined control of each site to denote "that an average of one untreated discharge may occur per year." A plan for the control of combined sewer overflows was developed for the City of Everett to comply with the new state regulations [Culp Wesner and Culp-Henningson, Durham and Richardson (CWC-HDR) and Ott Water Engineers 1987]. CWC-HDR and Ott Water Engineers classified the CSOs that discharge to Port Gardner into groups of outfalls (PS for Puget Sound and SR for Snohomish River), because the number of regulators made defining a single drainage basin for each outfall difficult. Outfalls to the Snohomish River were classified individually, but were given outfall group numbers for consistency. The individual outfalls and their associated groups were then modeled by CWC-HDR and Ott Water Engineers (Table 21). The purpose of modeling the CSO's was to determine the effects of alternative CSO control strategies on overflows in the Everett system. To evaluate alternative control facilities and strategies, CWC-HDR and Ott Water Engineers used a technical approach that involved Everett area rainfall data, CSO data, and an updated set of computer models.

Two basic types of models were used: 1) a detailed model based on the physical characteristics of the individual drainage basins, pipelines, pumping stations, and regulators (the HYDRA model); and 2) a model based on the hydrologic balance of rainfall, runoff, collection system capacity, and CSO spills (the PROVE model). Outfalls are modeled in PROVE by groups, which contain one or more outfalls. This grouping of outfalls was necessary because all overflow weirs are not the same and the proportion of diverted flow to nondiverted flow changes with total flow at each weir. This proportion is also dependent upon downstream conditions such as back-water surcharging. For this reason it is nearly impossible to define a single

TABLE 21. OUTFALLS AND THEIR ASSOCIATED GROUPS IN THE EVERETT HARBOR PROJECT AREA

Outfall Group Number	Combined Sewer Overflows
Port Gardner	
1	PS01, 2, 3
2	PS04, 5, 6, 7, 8
Snohomish River	
3	SR01
4	SR02
5	SR03 (siphon to treatment plant)
6	SR04
7	SR05, 6 (deactivated)
8	SR07
9	SR08

Reference: CWC-HDR and Ott Water Engineers (1987).

TABLE 22. SUMMARY OF LAND-USE CHARACTERISTICS IN THE SERVICE AREA FOR NESS

Land-Use Characteristics	Area
Total NESS	3,287 ac
Total impervious area[a]	1,123 ac
Total pervious area[b]	1,977 ac
Total NESS combined area	3,100 ac
Weighted percent impervious	36%

[a] Impervious areas are defined as areas incapable of being penetrated by moisture, such as parking lots and streets.

[b] Golf courses, lawns, parks, etc.

Reference: CWC-HDR and Ott Water Engineers (1987).

TABLE 23. OUTFALL GROUP OVERFLOW SUMMARY

Outfall Group No.	Outfalls	Approximate CSO Discharge Points	Service Area (ac)	Stormwater Capacity (MGD)	Average Annual Volume of Overflow (MG)	Annual Number of Events	Estimated 1-yr Return CSO Event Volume (MG)
1	PS01, 2, 3	PS01 13th Street PS02 14th Street PS03 16th Street	183	4.8	4.4	25	0.8
2	PS04, 5, 6 7, 8	PS04 25th Street PS05 Everett Avenue PS06 Hewitt Avenue PS07 Bond Street (between Wall Street and Pacific Avenue) PS08 Bond Street (between Wall Street and Pacific Avenue)	397	4.8	48.9	69	4.5
3	SR01	17th Street and Marine View Drive	61	0.4	5.4	79	0.5
4	SR02	17th Street and Marine View Drive	563	0.1	84.8	111	5.8
5	SR03	17th Street and Marine View Drive	Siphon Headworks - All basins contribute - Overflows are negligible	-----Negligible-----			
6	SR04	California Street and Railway Avenue	518	7.0	35.3	58	4.1
7	SR05, 6	SR05 Railway Avenue between Hewitt Avenue and California Street SR06 Railroad crossing between Hewitt Avenue and Pacific Avenue	Deactivated with the construction of the riverside interceptor	--------None--------			
8	SR07	Pacific Avenue and Railroad	488	6.0	36.3	58	3.7
9	SR08	36th Street and Railroad	890	5.0	269.9	101	18.9
		NESS COMBINED:	3,100	28.1	485.0	72[a]	38.3
ALL SYSTEM-WIDE		**NESS TOTAL:**	3,287	28.0	442	79	38

[a] Average.

Reference: Numbers taken from CWC-HDR and Ott Water Engineers (1987).

TABLE 24. APPROXIMATE DRAINAGE AREAS FOR THE SEVEN SUBBASINS SHOWN IN FIGURE 9

Subbasins	Area (ac)
A1	590
A2	560
A3	490
A4	340
A5	15
A6	640[a]
A7	320[a]

[a] Includes area south of 52nd Street.

TABLE 26. SUMMARY OF EVERETT CSO STORMWATER CONTAMINANT DATA

Detected Analytes	Mean Concentration (ug/L) PS05 (E009)	 PS06 (E008)	 SR07 (E026)	 SR08 (E028)	U.S. EPA (1986) Freshwater Quality Criteria (Aquatic Life) (ug/L) Acute	 Chronic
Arsenic	5.0	3.5	5.5	4.0	360	190
Antimony	5.0	5.0	5.0	5.0	9,000^{d}	1,600^{d}
Beryllium	5.5	3.0	5.0	5.0	130^{d}	5.3^{d}
Cadmium	5.0^{a}	1.0	2.0^{b}	1.75^{b}	3.9^{f}	1.1^{f}
Chromium	10.9	10.0	15.5^{b}	12.5^{b}	1700^{f}/16^{e}	210^{f}/11^{e}
Copper	51.0^{a}	36.0^{a}	78.0^{a}	121.5^{a}	18^{f}	12^{f}
Lead	32.0^{b}	35.5^{b}	55.0^{b}	125.0^{a}	82^{f}	3.2^{f}
Mercury	0.9^{b}	0.2^{b}	0.2^{b}	0.7^{b}	2.4	0.012
Nickel	28.0	5.0	11.5	21.0	1,400^{f}	160^{f}
Selenium	2.5	1.5	1.5	2.5	260	35
Silver	35.5^{a}	1.0^{b}	1.0^{b}	9.0^{a}	4.1^{f}	0.12
Thallium	1.0	2.0	1.0	1.5	1,400^{d}	40^{d}
Zinc	230.0^{a}	1,115.0^{a}	290.0^{a}	365.0^{a}	120^{f}	110^{f}
Phenol				53.6^{c}	10,200^{d}	2,560^{d}
4-Methylphenol		6.0^{c}			g	g
gamma-BHC				0.17^{c}	2.0	0.014
Diethyl phthalate	1.8^{c}	2.8^{c}		7.7^{c}	g	g
Di-n-butyl phthalate		2.0^{c}		26.7^{c}	g	g
Benzyl butyl phthalate		2.4^{c}			g	g
Bis(2-etnylhexyl) phthalate	228.0	9.8^{c}	5.2	37.8	g	g
Methylene chloride		1.8^{c}	17.0^{c}	8.35	g	g
Chloroform		2.9^{c}		7.0^{c}	28,900^{d}	1,240^{d}
Tetrachloroethane				8.4^{c}	9,320^{d}	g
Trichlorofluoromethane				3.2^{c}	g	g
Trichloroethylene				59.0^{c}	45,000^{d}	21,900^{d}
Trans-1,2-dichloroethylene				55.6^{c}	g	g
Toluene	63.2^{c}			34.8^{c}	17,500^{d}	g
Xylene		5.0^{c}			g	g
Acetone		95.0^{c}			g	g
Benzoic acid	17.0^{c}				g	g

[a] Concentration exceeds U.S. EPA acute criteria.

[b] Concentration exceeds U.S. EPA chronic criteria.

[c] Single concentration obtained from one sample. All other values represent means obtained from two samples collected from each CSO, each during different storm events (see Table 25, Section 2.3).

[d] Insufficient data to develop criteria. Value presented is the U.S. EPA lowest observed effect level (LOEL).

[e] The first value is for trivalent chromium (III) and the second value is for hexavalent chromium (VI).

[f] Hardness dependent criteria (100 mg/L used).

[g] No criteria or toxicity thresholds are presented in the water quality criteria documents.

Note: Other analytes were undetected at reasonable detection limits (see Table 42).

Reference: Data compiled from Mathias, D. (23 May 1988, personal communciation).

TABLE 28. ESTIMATED POLLUTANT LOADINGS FOR NESS

Outfall Group	Average Annual Volume MG	Mass Loading (lbs/yr) BOD	TSS	Lead	Cadmium	Zinc
1	4.4	1,066	2,422	8.4	0.10	8.4
2	48.9	24,225	32,449	105.9	1.20	101.8
3	5.4	1,430	3,143	9.4	0.10	11.7
4	84.4	22,240	49,988	148.3	0.70	155.3
6	35.3	8,964	19,251	67.6	0.90	76.4
8	36.3	8,311	16,774	84.6	0.30	78.6
9	267.9	111,527	173,090	535.3	4.50	557.6

Reference: Data from CWC-HDR and Ott Water Engineers (1987).

TABLE 29. SUMMARY OF EVERETT TIRE FIRE DATA

	Oil Samples[a] (mg/kg)		Water Samples[b] (ug/L)		Soil Samples (mg/kg)				
					c	d	d	d	d
LPAH	1,352	1,315	-	-	4.18	0.283	2.642	1.280	0.170
HPAH	891	760	-	-	15.4	3.33	3.81	0.610	3.62
2-Methyl-naphthalene	380	230	-	-	ND[e]	ND	0.190	0.420	ND
Dibenzofuran	--	ND	--	--	ND	0.018	0.250	0.060	ND
Zinc	--	--	89	125	196	129,800	61,200	22,200	80,000
Copper	--	--	31	28	108	140	230	84	164
Lead	--	--	<1	<1	116	705	128	56	204
Arsenic	--	--	10	3	12.7	31.4	11.0	7.4	13
Silver	--	--	<0.1	<0.1	0.3	1.1	0.4	0.1	0.4
Chromium	--	--	40	10	32.1	32.9	328	28.5	20.2
Cyanide	<10 ug/L	<10 ug/L	--	--	0.37	1.36	0.85	<0.41	<0.41

[a] Oil residue floating in drainage ditch.

[b] Surface water samples.

[c] Soil scraped from side of drainage ditch.

[d] Surface soils at site.

[e] ND = Not detected.

Reference: Huntamer (1985).

- No evidence of pesticide contamination was found at the site
- The potential exists for long-term, chronic contamination of the Snohomish River as a result of landfill leachate and runoff.

Currently, a chain-link fence surrounds the tire burn area at the landfill surface. No method of containment has been implemented to prevent the zinc-laden ash from becoming airborne or transported offsite by surface runoff.

2.4.2 Tulalip Landfill

The 150-ac landfill is located about 0.5 mi southwest of Marysville on an island in the Snohomish River delta (see Figure 2). It was operated by the Seattle Disposal Company between 1975 and 1979. The site was originally excavated to a maximum depth of approximately 10 ft below mean sea level. The excavated material was used to construct a dike around the perimeter of the site. A canal was built, extending into the fill area, to provide barge access for garbage originating in Seattle. There is no provision for disposal of leachate collected at the landfill.

Although there are no records of quantity or type of material disposed of at the site, it has been estimated that about 95 percent of the material was from commercial and industrial companies in Seattle (Ecology & Environment 1984). The landfill was closed in October 1979 under order from U.S. EPA because of concern over wetland destruction, water contamination, and complaints from Marysville residents of odor problems.

Bacterial Contamination--Because this report focuses on chemical contaminants, biological contaminants such as bacteria are not evaluated. However, because the landfill accepted wastes from hospitals in the Seattle area, there was some concern over the possibility of bacterial contamination from the site, particularly with respect to antibiotic resistant bacteria. While the landfill was in operation, U.S. EPA collected samples of water

TABLE 30. SUMMARY OF BACTERIOLOGICAL DATA FOR TULALIP LANDFILL[a]

Location	Total Coliform Bacteria	Fecal Coliform Bacteria	Fecal Streptococcus Bacteria	_Pseudomonas aeruginosa_	_Staphylococcus aureus_
Mouth of Barge Canal					
Surface water (No./100 mL)	3,300->16,000	170-450	330-1,300	20-34	320-330
Bottom water (No./100 mL)	24,000-92,000	180-1,700	4,900-35,000	0-220	600-4,500
Sediment (No./100 g)	24,000-130,000	450-4,900	-	-	-
Head Barge Canal					
Surface water (No./100 mL)	24,000-92,000	780-1,700	130-7,000	66-370	330-1,400
Bottom water (No./100 mL)	92,000-240,000	840-92,000	54,000-240,000	10-230	3,700-12,000
Sediment (No./100 g)	170,000-540,000	7,900-35,000	-	-	-
Ebey Slough (Reference)					
Surface water (No./100 mL)	950->16,000	310-2,400	140-180	2-60	40-170
Bottom water (No./100 mL)	330-16,000	20-170	45-<180	0-17	50-280
Sediment (No./100 g)	680-95,000	<180-7,000	-	-	-

[a] Samples taken at high and low tide.

Reference: Vasconcelos (1974a,b; 1976).

Class A water quality standards for bacteriological contamination in fresh waters of the State of Washington (Chapter 173-201 WAC) include:

> Fecal coliform organisms shall not exceed a geometric mean value of 100 organisms/ 100 mL, with no more than 10 percent of samples exceeding 200 organisms/100 mL.

The section of the Snohomish River in the area of the Tulalip landfill is classified as Class A water with special provisions, with fecal coliform organisms not to exceed a geometric mean value of 200 organisms/100 mL, with no more than 10 percent of the samples exceeding 400 organisms/ 100 mL.

- Groundwater from offsite domestic wells

- Leachate-stained sediment samples throughout the site.

These samples were analyzed for the compounds on U.S. EPA's Target Compound List. Results of this investigation were published in July 1988 but were not made available to the public in time for inclusion in this document.

2.5 SURFACE RUNOFF PATHWAYS

Most surface water runoff from the project area is discharged into Everett Harbor via natural drainages (e.g., streams and creeks). The primary sources of surface water runoff include the Snohomish River and its sloughs. Discharge from small creeks draining the portion of the basin between Mukilteo and Everett, constitute only a small fraction of the areas surface runoff. Because of the rural agricultural nature of most of the project area, there are few developed storm sewer networks.

2.5.1 Rivers and Creeks

Snohomish River Area--

Most surface runoff in the project area enters the main stem and sloughs (Ebey, Steamboat, and Union) of the Snohomish River (see Figure 2). The Snohomish River's annual flow, measured by the U.S. Geological Survey about 20 mi upstream of the mouth (near Monroe), averages 6,400 MGD. Metals data obtained during 1985-1986 at this station are presented in Table 32.

Another major carrier of surface runoff is the Marshland Drainage District Canal (see Figure 2). The canal flows into the Snohomish River above the Everett landfill and provides drainage to about 13,000 ac of agricultural land on the west side of the river and about 1,500 ac of urban land in the southeast end of Everett. Chemical contaminant data were not available for this potential surface water discharge source.

The Tulalip Tribes contracted with the Snohomish County Conservation District in May 1987 to monitor water quality associated with commercial agricultural areas in the Snohomish River Basin. Four rivers and six creeks are currently being sampled (i.e., Snohomish, Skykomish, Snoqualmie, and Pilchuck Rivers; and Cherry, Patterson, Woods, French, Allen, and Quilceda Creeks). Only conventional variables are being monitored (i.e., fecal bacteria, nitrate, ammonia, temperature, dissolved oxygen, and water height).

South Port Gardner Area--

The South Port Gardner drainage basin extends from Elliott Point at Mukilteo on the west side to near Federal Avenue in Everett on the east side. The area is drained by 10 separate creeks (see Figure 2). Japanese Gulch and Powder Mill Gulch drain the largest industrial areas around Paine Field.

Drainage area and estimated discharges for the 1-yr storm (24-h storm event with a 1-yr recurrence interval) for major streams and storm drains in the South Port Gardner area are shown in Table 33. Water quality data for these drainages are either unavailable or are limited to analyses of a single base flow sample. The pollutant loadings were calculated from estimated flows and the available chemical data and are shown in Table 34.

In August 1987, Ecology collected water and sediment samples from the five major drainages serving Paine Field and analyzed for priority pollutants and hazardous substances. The five drainages included Big Gulch, Japanese Gulch, Powder Mill Gulch, Stickney Lake, and Swamp Creek. The laboratory results were not available to be included in this report. The final report on the characterization of runoff from the Paine Field Survey will be completed by early October 1988 (Johnson, A., 16 August 1988, personal communication).

2.5.2 Storm Drains

The South Port Gardner area is drained by numerous small storm drains along Mukilteo Boulevard in southwest Everett. Within the City of Mukilteo

TABLE 34. LOADING ESTIMATES FOR CONVENTIONAL POLLUTANTS AND SELECTED METALS FROM SURFACE RUNOFF DISCHARGES BASED ON A 1-YR STORM[a]

Source	TSS (lb)	BOD (lb)	Lead+Copper+Zinc (lb)
South Port Gardner			
Powder Mill Gulch	15,000	940	31
Pigeon Creek #1	--	1,470	6
Japanese Gulch	8,400	560	20
Pigeon Creek #2	6,300	420	15
Merrill and Ring Creek	3,600	240	8
Narbeck Creek	2,850	190	7
Glenwood Creek	2,800	60	2
Mukilteo Storm Drain #2	1,350	90	2
Edgewater Creek	450	30	1
Seahurst-Glenhaven Creek	1,950	130	5
Phillips Creek	5	3	<1
Mukilteo Storm Drain #1	450	3	1
Ebey Slough			
Quilceda Creek	--	2,460	--
Allen Creek	--	820	--
Ebey Slough Storm Drain	5,700	380	14
Snohomish River			
Marshland Canal	--	3,520	--
Tidegates	--	3,570	--
Snohomish River near Monroe	--	--	1,100

[a] 1-yr storm is defined as a 24-h storm event with a 1-yr recurrence interval.

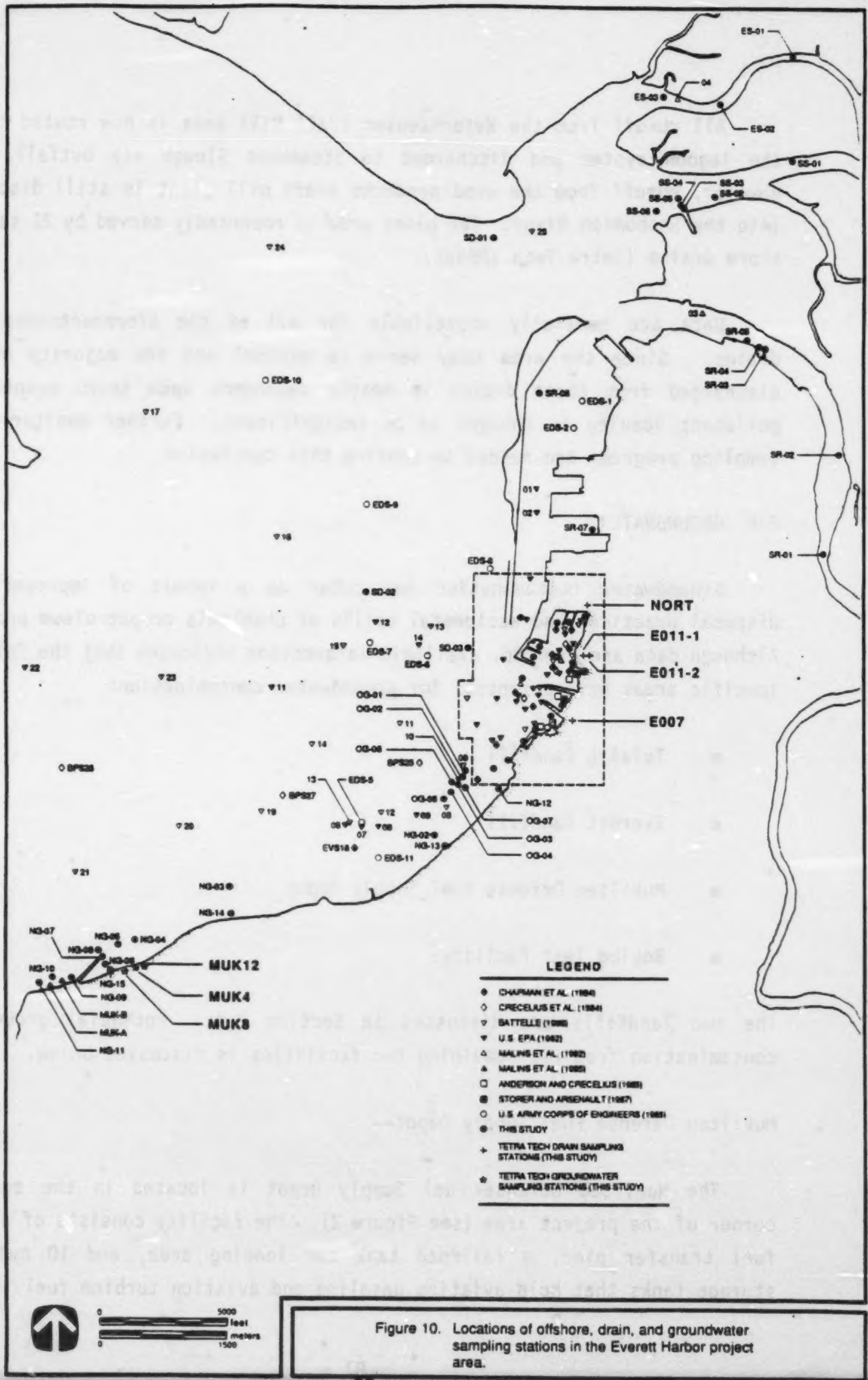
ES-01
04
ES-03
ES-02
SS-01
SS-04
SS-03
SS-05
SS-02
SS-06
SD-01
25
24
03
SR-05
SR-04
SR-03
EDS-10
SR-06
EDS-1
17
EDS-2
SR-02
01
02
EDS-9
SR-07
16
SR-01
EDS-3
SD-02
NORT
12
13
E011-1
14
19
SD-03
EDS-7
EDS-6
E011-2
22
23
11
OG-01
OG-02
11
10
E007
14
OG-05
BPS28
BPS26
13
EDS-5
NG-12
BPS27
19
12
OG-06
09
OG-07
20
08
06
NG-02
OG-03
07
NG-13
OG-04
EVS18
EDS-11
21
NG-03
NG-14
NG-07
NG-06
NG-04
NG-08
NG-05
MUK12
NG-10
NG-15
MUK4
NG-09
MUK-B
MUK8
MUK-A
NG-11
LEGEND
CHAPMAN ET AL. (1984)
CRECELIUS ET AL. (1984)
BATTELLE (1986)
U.S. EPA (1982)
MALINS ET AL. (1982)
MALINS ET AL. (1980)
ANDERSON AND CRECELIUS (1985)
STORER AND ARSENAULT (1987)
U.S. ARMY CORPS OF ENGINEERS (1985)
THIS STUDY
TETRA TECH DRAIN SAMPLING STATIONS (THIS STUDY)
TETRA TECH GROUNDWATER SAMPLING STATIONS (THIS STUDY)
0
5000
feet
meters
0
1500

Figure 10. Locations of offshore, drain, and groundwater sampling stations in the Everett Harbor project area.

All runoff from the Weyerhaeuser Kraft Mill area is now routed through the lagoon system and discharged to Steamboat Slough via Outfall WK001. However, runoff from the wood products kraft mill plant is still discharged into the Snohomish River. The plant area is reportedly served by 21 separate storm drains (Tetra Tech 1985b).

Data are generally unavailable for all of the aforementioned storm drains. Since the area they serve is minimal and the majority of flow discharged from these drains is mostly dependent upon storm events, the pollutant loading is thought to be insignificant. Further monitoring and sampling programs are needed to confirm this conclusion.

2.6 GROUNDWATER

Groundwater contamination may occur as a result of improper waste disposal practices and accidental spills of chemicals or petroleum products. Although data are limited, available information indicates that the following specific areas have potential for groundwater contamination:

- Tulalip landfill
- Everett landfill
- Mukilteo Defense Fuel Supply Depot
- Boeing Test Facility.

The two landfills are discussed in Section 2.4. Potential groundwater contamination from the remaining two facilities is discussed below.

Mukilteo Defense Fuel Supply Depot--

The Mukilteo Defense Fuel Supply Depot is located in the southwest corner of the project area (see Figure 2). The facility consists of a marine fuel transfer pier, a railroad tank car loading area, and 10 bulk fuel storage tanks that hold aviation gasoline and aviation turbine fuel (JP-4).

TABLE 35. SUMMARY OF DATA FROM MONITORING WELLS AT THE MUKILTEO DEFENSE FUEL SUPPLY DEPOT

	Well 4	Well 6	Well 9
Benzene (ug/L) (9/82)	100-200	2,000-4,000	NA[a]
Ethyl benzene (ug/L) (9/82)	400-500	200-300	NA
Toluene (ug/L) (9/82)	<10	100-150	NA
Chloroform (ug/L) (9/82)	<10	<10	NA
JP-4 (mg/L) (9/82)	<1	1.1	NA
(5/83)	8,400	72	--
(6/83)	200,000	22	4
(7/83)	450,000	27	--

[a] NA = Not analyzed.

TABLE 36. SUMMARY OF SOURCE EMISSIONS IN THE EVERETT HARBOR PROJECT AREA

Registration Number	Source	Emission in Tons for 1987						
		SOX[a]	TSP[b]	NOX[c]	PM10[d]	CO[e]	VOC[f]	TAC
21400	Snohomish Co. (Paine Field) Airport	7	9	36	9	730	35	0
13120	Boeing Commercial Airplane (Everett)	55	14	222	13	6,423	860	622
10169	Associated Sand and Gravel Co., Inc.		224	9	38	2	0	3
16000	U.S. Defense Fuel Supply Agency DLA						20	
16338	TIZ's Door Sales, Inc.						12	11
16006	Providence Hospital							1
12164	Scott Paper Co. Northwest Operations	405	455	1,319	371	3,404	223	68
14024	Everett Port Facilities		185		7			
14121	Sound Casket Mfg., Co., Inc.						2	2
11271	Centrecon, Inc.		12		1			
10663	Nord/Jeld-Wen of Everett, Inc.	0	167	10	113	94	5	13
12425	Alpine Retreaders (J&V Investments)						2	2
12754	Weyerhaeuser Co., Kraft Mill	840	549	147	287	993	3	22
	Totals	1,307	1,615	1,743	839	11,646	1,162	744

[a] SOX = Any sulfur oxides.

[b] TSP = Total suspended particulates.

[c] NOX = Any nitrogen oxides.

[d] PM10 = Particulate matter <10 microns in size.

[e] CO = Carbon monoxide.

[f] VOC = Volatile organic compounds.

Reference: Anderson, J. (8 June 1988, personal communication).

2.8 SPILLS

Information on accidental spills on land and water in the area is limited. Ecology maintains a file on spill complaints reported by private citizens. These reports usually contain information on the date and location of the spill, a description of what and how much was spilled, and the cleanup measures taken. Typically, there is insufficient information available to calculate contaminant loadings.

The U.S. Coast Guard maintains a file on marine spills. Spills were recorded for the project area beginning in 1972 (Linch, Lt. Commander, 14 June 1988, personal communication). Spill information includes the date, location, type of material, and estimated quantity spilled. The reported spills consisted primarily of petroleum products (i.e., gasoline, diesel, fuel oil, jet fuel, and waste oil). However, because the location is given by latitude and longitude to the nearest minute, it is impossible to determine the exact location of the spill. Also, because there is no information on the amount of spilled material recovered from cleanup operations, it is not possible to evaluate total loading of contaminants to the Everett Harbor project area. The Mukilteo Defense Fuel Supply Depot has had a number of fuel spills (see Section 2.1).

The EAR technique is a comparison of drain sediment data with offshore receiving environment sediment data collected from reference areas (i.e., noncontaminated areas). EAR values are calculated by dividing the concentration of a contaminant measured in the drain sediments by the concentration of that same contaminant measured in the reference area sediments.

The focus of the AET approach is to identify concentrations of chemical contaminants in sediments that are associated with statistically significant biological effects (relative to reference conditions). Biological indicators used to develop AET values include:

- Depression in abundances of major taxonomic groups of benthic infauna (e.g., Crustacea, Mollusca, Polychaeta)
- Amphipod mortality bioassay using *Rhepoxynius abronius*
- Oyster larvae abnormality bioassay using *Crassostrea gigas*
- Microtox bioluminescence bioassay using *Photobacterium phosphoreum*.

For a given chemical and a specific biological indicator, the AET is the concentration above which statistically significant biological effects occurred in all samples of sediments analyzed.

AET values have been proposed for 64 organic and inorganic toxic chemicals using synoptic chemical and biological data from 200 stations in Puget Sound (Tetra Tech 1987). For each chemical, a separate AET was developed for each biological indicator listed above, resulting in four sets of AET values. A list of the highest (HAET) and lowest AET (LAET) for each chemical is provided in Table 38.

Contaminants for which HAET values are unavailable were selected as problem chemicals if elevated above reference concentrations were more than

TABLE 38. (Continued)

	Lowest AET	Highest AET
Phenols		
Phenol	420	1,200
2-Methylphenol	63	63
4-Methylphenol	670	1,200
2,4-Dimethyl phenol	29	29
Pentachlorophenol	--	--
2-Methoxyphenol	930	930
Miscellaneous Extractables		
Hexachlorobutadiene	120	290
1-Methylphenanthrene	310	370
2-Methylnaphthalene	670	670
Biphenyl	260	270
Dibenzothiophene	240	250
Dibenzofuran	540	540
Benzyl alcohol	57	73
Benzoic acid	650	650
n-Nitrosodiphenylamine	40	220
Volatile Organic Compounds		
Tetrachloroethene	140	140
Ethyl benzene	33	37
Total xylenes	100	120
Metals		
Antimony	3.2	26
Arsenic	85	700
Cadmium	5.8	9.6
Copper	310	800
Lead	300	700
Mercury	0.41	2.1
Nickel	28	49
Silver	5.2	5.2
Zinc	260	1,600

[a] LPAH = Low molecular weight polynuclear aromatic hydrocarbons.

[b] HPAH = High molecular weight polynuclear aromatic hydrocarbons.

Reference: Tetra Tech (1987).

TABLE 39. SUMMARY OF U.S. EPA WATER QUALITY CRITERIA (UG/L)

	Freshwater Aquatic Life[a]		Saltwater Aquatic Life[a]	
	Acute Toxicity	Chronic Toxicity	Acute Toxicity	Chronic Toxicity
Metals				
Antimony	(9,000)	(1,600)	b	b
Arsenic	360	190	69	36
Beryllium	(130)	(5.3)	b	b
Cadmium	3.9[c]	1.1[c]	43	9.3
Chromium	1,700[c]/16[d]	210[c]/11[d]	(10,300)/1,100[d]	50
Copper	18[c]	12[c]	2.9	2.9
Lead	82[c]	3.2[c]	140	5.6
Mercury	2.4	0.012	2.1	0.025
Nickel	1,400[c]	160[c]	75	8.3
Selenium	260	35	410	54
Silver	4.1[c]	0.12	2.3	b
Thallium	(1,400)	(40)	(2,130)	b
Zinc	120[c]	110[c]	95	86
Cyanide	22	5.2	1	1
LPAH				
Naphthalene	(2,300)	(620)	(2,350)	b
Acenaphthylene	b	b	b	b
Acenaphthene	(1,700)	(520)	(970)	(710)
Fluorene	b	b	b	b
Phenanthrene	b	b	b	b
Anthracene	b	b	b	b
HPAH	b	b	b	b
Fluoranthene	(3,980)	b	(40)	(16)
Pyrene	b	b	b	b
Benzo(a)anthracene	b	b	b	b
Chrysene	b	b	b	b
Total benzofluoranthenes	b	b	b	b
Benzo(a)pyrene	b	b	b	b
Indeno(1,2,3-c,d)pyrene	b	b	b	b
Dibenzo(a,h)anthracene	b	b	b	b
Benzo(g,h,i)perylene	b	b	b	b
PAH Total	b	b	(300)	b

TABLE 39. (Continued)

	Freshwater Aquatic Life[a]		Saltwater Aquatic Life[a]	
	Acute Toxicity	Chronic Toxicity	Acute Toxicity	Chronic Toxicity
Volatiles				
Acrylonitrile	(7,550)	(2,600)	[b]	[b]
Acrolein	(68)	(21)	(55)	[b]
Benzene	(5,300)	[b]	(5,100)	(700)
Trichloromethane (chloroform)	(28,900)	(1,240)	[b]	[b]
Tetrachloromethane (carbon tetrachloride)	(35,200)	[b]	(50,000)	[b]
1,2-dichloroethane	(118,000)	(20,000)	(113,000)	[b]
Dichloroethylenes	(11,600)	[b]	(224,000)	[b]
Dichloropropanes	(23,000)	(5,700)	(10,300)	(3,040)
Dichloropropenes	(6,060)	(244)	(790)	[b]
Ethyl benzene	(32,000)	[b]	(430)	[b]
Halomethanes	(11,000)	[b]	(12,000)	(6,400)
Pentachlorinated ethanes	(7,240)	(1,100)	(390)	(281)
Tetrachloroethanes	(9,320)	[b]	[b]	[b]
1,1,2,2-Tetrachloroethane	[b]	(2,400)	(9,020)	[b]
Tetrachloroethylene	(5,280)	(840)	(10,200)	(450)
Toluene	(17,500)	[b]	(6,300)	(5,000)
Trichloroethanes	(18,000)	[b]	[b]	[b]
1,1,1-Trichloroethane	[b]	[b]	(31,200)	[b]
1,1,2-Trichloroethane	[b]	(9,400)	[b]	[b]
Trichloroethylene	(45,000)	(21,900)	(2,000)	[b]
Miscellaneous Oxygenated Compounds				
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	(0.01)	(0.00001)	[b]	[b]
Isophorone	(117,000)	[b]	(12,900)	[b]
Organonitrogen Compounds				
Benzidine	(2,500)	[b]	[b]	[b]
Dinitrotoluene	(330)	(230)	(590)	(370)
Nitrobenzene	(27,000)	[b]	(6,680)	[b]
Nitrosamines	(5,850)	[b]	(3,300,000)	[b]
1,2-Diphenylhydrazine	(270)	[b]	[b]	[b]

stations identified in the receiving environment was a major factor in the source evaluations.

The problem chemicals identified in the sources were also compared with the problem chemicals identified in the offshore sediments. If the problem chemicals differed between the source and the offshore sediments, it is unlikely that the source was a major contributor to the contamination problem.

To further evaluate the extent of contaminant contribution from drains or waterfront activities, the relative percent distributions of chemical concentrations were used to compare the offshore sediment samples with the drain sediments. A relative distribution was obtained by calculating the percentage contribution (by concentration) of a particular chemical or compound within a related group of chemicals (e.g., HPAH, LPAH, or metals). Plots of the relative percent distributions were used to compare source sediment samples with offshore sediment samples. If the relative percent distributions of chemicals differed between the source and offshore sediments, it is unlikely that the source was a major contributor to the contamination problem.

Evaluation of the spatial distribution of contaminants in the offshore sediments aids in the identification of sources. For example, widespread contamination in the offshore sediments suggests that there may be multiple sources contributing to the contamination. In addition, concentration gradients, which are frequently apparent in the offshore sediments, can help identify a particular source or sources.

Information obtained from agencies familiar with an area's past or ongoing industrial practices can be used to link sources to problem areas in the receiving environment. Information on industrial practices in the project area has been obtained from Ecology, U.S. EPA, the City of Everett, the Snohomish County Health Department, and the Port of Everett.

Dredging can affect the distributions of contaminants in offshore sediments. Therefore, dredging was considered in the evaluation of the sediment samples collected are presented in Table 40. The original sampling plan called for the sampling of six drains. However, Lift Station #2 CSO (E006) and the West Hewitt and Bond Street CSO (E008) were not sampled because 1) of difficulties in reaching manholes at log storage facilities, 2) several manholes were inundated by tidal water (the lowest tide during the study was 2 ft mean lower low water (MLLW), and 3) CSO discharge volumes were expected to be negligible (Tetra Tech 1986d).

Drain sediment samples were collected, using stainless steel scoops and spoons, from sediment deposits in the manhole and/or the drain line at each sampling location (Tetra Tech 1986f). Sampling personnel collected separate duplicate subsamples for volatile organic analyses. These subsamples were placed in 40-cm^3 glass vials while personnel were still in the manhole. Samples for the remaining chemical and physical analyses were placed in a precleaned stainless steel bucket and brought to the surface of the manhole prior to filling sample containers. This procedure minimized the time that the sampling personnel were in the manhole. Samples were homogenized (except those intended for volatile organic analyses) and placed in the following containers for analyses:

- For extractable organic compound analysis, 500 cm^3 of sample were transferred to a precleaned glass jar, equipped with a polytetrafluoroethane-cap liner.
- For metals analysis, 125 cm^3 of sample were transferred to a precleaned glass jar.
- For grain size analysis, 100 cm^3 of sample were transferred to a resealable plastic bag.

In addition to the four sediment samples, four groundwater samples (including one field replicate) were collected from three monitoring wells at the Mukilteo Defense Fuel Supply Depot. A summary of the monitoring wells investigated, the depth at which samples were taken, and observations noted during the sampling effort are presented in Table 41.

TABLE 41. MONITORING WELLS SAMPLED AT THE MUKILTEO DEFENSE FUEL SUPPLY DEPOT

Monitoring Well	Sample I.D.	Sample Collection Date	Water Table (Depth Below Surface, ft)	Comments
MW-4[a]	MUK4 MUK4D	10/16/86	8	Strong fuel smell, black greasy sediment at bottom of well, sheen on water.
MW-8	MUK8	10/16/86	8.3	Water clear, no odor, no sheen.
MW-12	MUK12	10/16/86	9.8	Water tan-colored, lots of sediment in sample.

[a] Field duplicate collected from this well.

compound as a recovery standard. All reported concentrations were corrected for recovery using the isotope dilution technique. Recoveries of isotope-labeled standards were determined by the internal standard technique.

Analyses for 34 volatile organic compounds were performed on all four sediment source samples and on the four groundwater samples. The samples were analyzed for volatile organics using the purge-and-trap GC/MS technique specified in the U.S. EPA Contract Laboratory Program (CLP) protocols.

Six miscellaneous extractable compounds were analyzed in the source samples. Several of these are PAH compounds (2-methylnaphthalene, 1-methylpyrene, dibenzofuran, and dibenzothiophene). In addition, 15 TIO compounds were measured in the source sediment samples (Table 42). These compounds are found during GC/MS analysis and are tentatively identified by searching for a match between the compound's mass spectrum and one of the thousands of mass spectra contained in a computer database. Generally, the largest peaks in the sample chromatograms that do not correspond to target compounds are selected for tentative identification.

Pesticides and PCBs--

Nineteen pesticides (Table 42) were analyzed by gas chromatography/electron capture detection (GC/ECD). The analytical method originally specified to the laboratory is described in Tetra Tech (1986a). This procedure calls for extraction of a 100-g (wet-weight) sample with removal of 20 percent of the extract for GC/ECD analysis of pesticides and PCBs. For this project, a pesticide/PCB sample was extracted separately from the acid and base/neutral sample that was to be analyzed by GC/MS. A 40-g (wet-weight) aliquot was extracted and processed according to the protocol. Both quantitation and confirmation were performed using packed columns and U.S. EPA CLP protocols, rather than the capillary columns originally specified in Tetra Tech (1986a). Most of the sample extracts were diluted to minimize interference from nontarget compounds.

Sediment samples were analyzed for total PCBs, while the groundwater samples were analyzed for individual Aroclor mixtures. Analyses of PCBs in

TABLE 42. (Continued)

- 2,4-dinitrophenol[a]
- 4,6-dinitro-2-methylphenol
- 4-chloroaniline[b]
- 2-nitroaniline
- 3-nitroaniline
- 4-nitroaniline
- 2,4-dinitrotoluene[a]
- 2,6-dinitrotoluene[a]
- 3,3'-dichlorobenzidine[a]

Halogenated Ethers
- bis(2-chloroethyl)ether[a]
- bis(2-chloroisopropyl)ether[a]
- bis(2-chloroethoxy)methane[a]
- 4-chlorophenyl phenyl ether[a]
- 4-bromophenyl phenyl ether[a]

Miscellaneous Extractables and Tentatively Identified Organic Compounds
- benzyl alcohol
- benzoic acid[b]
- dibenzofuran
- 2-methylnaphthalene
- isophorone[a]
- hexachlorocyclopentadiene[a]
- 1-methylpyrene[c]
- retene[c]
- cymene (unspecified isomer)[c]
- dibenzothiophene[c]
- 1,2,4-trithiolane[c]
- diterpenoid hydrocarbon[c] (base peak 255)
- diterpenoid alcohol[c] (base peak 271)
- hexadecanoic acid[c]
- hexadecanoic acid methyl ester[c]
- hexadecenoic acid methyl ester[c]
- cholesterol[c]
- campesterol[c]
- alkanol (unidentified)[c]
- base peak 181, isomer #1[c]
- base peak 181, isomer #2[c]

Volatile Organic Compounds
- acetone
- benzene
- bromodichloromethane
- bromoform
- bromomethane
- 2-butanone
- carbon disulfidecarbon
- tetrachloride
- chlorobenzene
- chloroethane
- 2-chloroethylvinyl ether
- chloroform
- chloromethane
- dibromochloromethane
- 1,1-dichloroethane
- 1,2-dichloroethane
- 1,1-dichloroethene
- trans-1,2-dichloroethene
- 1,2-dichloropropane
- cis-1,3-dichloropropene
- trans-1,3-dichloropropene
- ethylbenzene
- 4-methyl-2-pentanone
- 2-hexanone
- styrene
- 1,1,2,2-tetrachloroethane
- tetrachloroethene
- 1,1,1-trichloroethane
- 1,1,2-trichloroethane
- trichloroethene
- toluene
- total xylenes
- vinyl acetate
- vinyl chloride

Metals
- antimony[a]
- arsenic[a]
- cadmium[a]
- chromium[a]
- copper[a]
- iron
- lead[a]
- manganese
- mercury[a]
- nickel[a]
- selenium[a]
- silver[a]
- zinc[a]

Conventional Variables
- total solids
- percent fine-grained material

---

[a] U.S. EPA priority pollutant.

[b] U.S. EPA hazardous substance list compound.

[c] Tentatively identified organic compound.

Ancillary Analyses--

Total solids and grain size were the only conventional variables measured in the source sediment samples. The procedures used for grain size and total solids determinations were in accordance with PSEP recommendations (Tetra Tech 1986e).

3.2.3 Chemical Analyses

The contaminants measured during the onshore source investigation were generally identical to those contaminants analyzed in the offshore sediments (PTI and Tetra Tech 1988b). This facilitated comparisons between variables measured in the two sampling efforts.

Data for 143 analytes, including 80 U.S. EPA priority pollutants and 5 additional organic compounds listed in the hazardous substance list were reported for the source sediment samples collected during the Everett Harbor Action Program (see Table 42). In addition, 2 conventional sediment quality variables (grain size and total solids) and 15 tentatively identified organic (TIO) compounds were measured.

The groundwater samples were analyzed for the same compounds as the sediment samples, with the exception of the conventional variables, iron, manganese, resin acids, chlorinated phenols and guaiacols, and the TIOs.

Most of the analytes of interest mentioned above have at least one of the following two properties: 1) they bioaccumulate, possibly with adverse biological effects in the food chain, or 2) they produce adverse biological effects even when not bioaccumulated. U.S. EPA-priority pollutants discharged into the project area are identified in Table 42 (see Section 3.2.2). Certain compounds that are not U.S. EPA-priority pollutants have been measured because of their local significance. For example, of particular interest are those substances that may be associated specifically with pulp mills, such as resin acids and chlorinated phenolic compounds.

Assessment of the Effect of Analytical Procedures on Metals Results--

The analytical methods used to determine metals in this study were designed to measure the total concentrations of metals in sediments, in contrast to methods that involve partial digestion. A small study was conducted to examine the implications of using the "total metals" methods (per PSEP protocols), especially when comparing results to reference area data (e.g., reference data from Carr Inlet) generated by "strong acid" methods, per U.S. EPA CLP. Two archived Carr Inlet samples collected during the Commencement Bay Remedial Investigation (Tetra Tech 1985a) were analyzed in triplicate using the "total metals" method from the present study, and the "strong acid" method used during the Commencement Bay study. In addition, selected samples collected during the Elliott Bay sampling effort (PTI and Tetra Tech 1988a) were analyzed by the "total metals" and "strong acid" methods for comparison purposes. The results of that comparison are presented in PTI and Tetra Tech (1988a) and are summarized below.

Differences were observed for a number of metals analyzed by both methods. However, the largest and most consistent differences were observed for chromium. In both Carr Inlet samples, mean chromium concentrations by "total metals" methods (in this case, XRF) were more than 4 times the mean concentrations determined by the "strong acid" technique. Results from samples from Port Susan and Elliott Bay/Duwamish River, with higher overall chromium concentrations, were generally a factor of 2 greater when analyzed by "total metals" methods than when "strong acid" methods were used.

Differences between antimony results by "total metals" vs. "strong acid" methods could not be determined for Carr Inlet samples because antimony was consistently undetected by the "strong acid" procedure. However, concentrations of antimony reported for Samples CR-11 and CR-13 using "strong acid" methods during the Commencement Bay Remedial Investigation were approximately 15 times lower than the "total metals" values. Similarly, for Duwamish River offshore sediment samples WW-12 and EW-15 collected during the Elliott Bay study (PTI and Tetra Tech 1988a), the "total metals" procedure [including hydrogen fluoride digestion and analysis by gas furnace atomic absorption (GFAA)] resulted in concentrations 10-20 times dilutions, no precision and accuracy data were obtained for the pesticide/PCB analyses. However, the review of calibration data suggested that the analytical instrument was operating within acceptable limits. Data qualifiers were not assigned to positive pesticide results.

Source sediment samples were analyzed for total PCBs and groundwater samples were analyzed for individual Aroclor mixtures. All sample data for total PCBs are considered acceptable when qualified as estimates. Qualification was necessary because only single-point calibration was used for quantification. All concentrations greater than 50 ug/kg were determined by GC/MS analyses, because of interferences encountered during GC/ECD analyses. Extracts for GC/MS analysis were held longer than the 40-day holding time specified in U.S. EPA CLP protocols. The extended extract holding time might have resulted in either an underestimate or an overestimate of original sample concentrations. An underestimate may have resulted from degradation of PCBs, but such degradation would not be expected because of the well-documented stability of this class of compounds (Hutzinger et al. 1974). However, an overestimate of the PCB concentration may have resulted from loss of solvent volume in the extract to evaporation.

Pulp Mill Compounds--

Overall, data for resin acids and chlorinated phenols/guaiacols are considered acceptable. Palustric acid data were rejected based on 0 percent recoveries in both matrix spikes. Data were qualified with an E for several possible reasons: 1) data were reported at a concentration corresponding to less than half the lowest calibration standard; 2) data were associated with an ongoing calibration that was outside PSEP limits; or 3) the interpretation of the mass spectrum was questionable.

Ancillary Analyses--

The overall quality of the total solids and grain size data is acceptable. The accuracy of the method for sediment grain size analysis (Tetra Tech 1986e) has not been assessed by the use of SRMs. Recovery is examined by comparing the sum of the fraction weights with the calculated

4.0 CHARACTERIZATION OF ONSHORE SAMPLES

The results from the analyses of the Everett Harbor Action Program onshore samples are presented in Appendix A. For sediment samples, analytical concentrations of metals are in mg/kg dry weight and organic compounds are reported in ug/kg dry weight. Unless otherwise noted, all sediment concentrations are reported in dry weight. For groundwater samples, all units are ug/L. Data qualifiers are included with concentrations throughout this report. A complete description of data qualifiers is presented in Appendix A.

4.1 DRAIN SEDIMENTS

Four drain sediment samples were collected during the onshore sampling effort. One sample (E007) was taken from CSO E007, two samples (E011-1 and E011-2) were taken from Manholes 1 and 2, respectively, on CSO E0I1, and one sample (NORT) was taken from the Norton Terminal storm drain (SD). The locations of these drain sampling points, as well as the approximate locations of the drain outfalls, are shown in Figure 4 (see Section 2.1).

4.1.1 Conventional Sediment Characteristics

The grain size characteristics of the drain sediment samples are presented in Appendix A. Three of the four drains contained sediments that were primarily sand. The fourth drain, the Norton Terminal SD, contained sediment that was sandy silty clay. Drain sediments typically contain more coarse-grained materials than fine-grained materials because the fine-grained particles are flushed out of the drain rather than deposited. In general, the sediments from the drains were more coarse-grained than the sediments from nearby offshore stations (Appendix D).

approach is not possible for the Everett Harbor drain sediments because of the limited number of samples, so HAET values have been used instead.

As discussed in Section 3.2.4 of this report, comparisons of chromium and antimony data from this study with similar data from past studies is difficult because of differences in laboratory analytical procedures. The concentrations of chromium reported in the Everett Harbor drain sediments may be overestimated by a factor of 2 to 4 when compared to the data reported for the Carr Inlet reference area (see Section 3.2.4). However, the concentrations of chromium in all four of the Everett Harbor drain sediments exceeded the HAET concentration by a factor of 2 to 4, and chromium was therefore considered a potential problem chemical in all four sediments. Similarly, the concentrations of antimony in the four Everett Harbor drain sediments may be overestimated by a factor of 5 or more when compared to the data reported for Carr Inlet. However, antimony was not found at concentrations exceeding HAET in any of the four Everett Harbor drain sediments, and was consequently not identified as a problem chemical in those sediments.

Table 43 lists the problem chemicals found in the four Everett Harbor project area drain sediments. Chromium was the only problem chemical identified in all four drain sediments. Nickel was a problem chemical in three of the drain sediments. Dibenzofuran was a problem chemical in two of the drain sediments. All other problem chemicals were identified in only one of the drain sediments.

Sediment samples E011-1 and E011-2 were collected from two manholes approximately 200 ft apart on CSO E011. (Manhole 2 is upstream of Manhole 1). Similarities between the two samples are not as great as might be expected, given their proximity to each other. Both samples contained a greater number of problem chemicals than the samples from the other drains. Chromium and dibenzofuran were problem chemicals in both the samples. However, there were some noteworthy differences between the two samples. The sediment from Manhole 1 (E011-1) was brown in color (Tetra Tech 1986b) and coarse-grained (93 percent sand; see Appendix A). In contrast, the sediment from Manhole 2 (E011-2) was black (Tetra Tech 1986b) and fine-grained (57 percent sand, 30 percent clay; see Appendix A). Both sediments contained LPAH compounds, but at dissimilar concentrations, which resulted in the identification of different LPAH compounds as problem chemicals in the two sediments. Problem chemicals that were identified in Sample E011-1 and not Sample E011-2 included acenaphthene, total LPAH, 4-methylphenol, and benzoic acid. However, benzoic acid was undetected in the E011-2 sediment at a detection limit that exceeded HAET. Problem chemicals that were found in Sample E011-2 and not Sample E011-1 include nickel, cadmium, zinc, naphthalene, acenaphthylene and dimethyl phthalate. These differences may be the result of multiple contaminant sources within the drainage basin, or may be attributable to the differences in the grain sizes of the two samples.

Table 44 contains the list of chemicals that were undetected in the four drain sediments, but had detection limits greater than or equal to the HAFT concentration. These chemicals could have been present in the sediments at levels exceeding the HAET, but it is impossible to determine if they actually were. Consequently, they have not been listed as problem chemicals.

4.2 GROUNDWATER SAMPLES

As part of the onshore sampling effort for this study, four groundwater samples were collected from three monitoring wells at the Mulkilteo Defense Fuel Supply Depot. A sample and field duplicate (MUK 4 and MUK 4D) were collected from monitoring Well 4. The third sample (MUK8) was collected from monitoring Well 8, and the fourth sample (MUK12) was collected from monitoring Well 12. The locations of these sampling points are shown in Figure 6 (see Section 2.1.3). These four samples were collected because of suspected leakage of JP-4 jet fuel from Tank 10 at the depot (Tetra Tech 1986b).

The results from the analysis of these samples are presented in Table 45, along with the U.S. EPA freshwater quality criteria for aquatic life. The criteria do not represent enforceable standards, which are instead established by the State of Washington in WAC 173-201-047. Additionally, the criteria presented in Table 45 apply to surface waters, not groundwater. They are presented for comparison purposes only, to provide a general, qualitative description of acceptable water quality.

TABLE 45. SUMMARY OF RESULTS FROM ANALYSIS OF GROUNDWATER AT MUKILTEO DEFENSE FUEL SUPPLY DEPOT OCTOBER 1986[a]

	Wells (ug/L)				U.S. EPA (1986) Freshwater Quality Criteria (Aquatic Life) (ug/L)	
	MUK 4	MUK 4D[b]	MUK 8	MUK 12	Acute	Chronic
Antimony	2.7	4.1	8.1	5.4	9,000[d]	1,600[d]
Arsenic	3.04	2.35	5.79	1.00	360	190
Cadmium	0.144	0.098	0.0808	0.0284	3.9[e]	1.1[e]
Chromium	6.13	6.07	7.65	1.66	1,700[e]/16[f]	210[e]/11[f]
Copper	E10.2	E6.69	E14.7[c]	E2.18	18[e]	12[e]
Lead	12.3[c]	1.23	7.08[c]	1.83	82[e]	3.2[e]
Mercury	E0.03[c]	E0.004	E0.0003	E0.0008	2.4	0.012
Nickel	7.24	6.82	14.5	1.21	1,400[e]	160[e]
Silver	0.0655	0.125[c]	0.0198	0.0083	4.1[e]	0.12
Zinc	18.0	19.6	22.7	3.60	120[e]	110[e]
Acenaphthene	30	21	U10	U10	1,700[d]	520[d]
Fluorene	26	15	U10	U10	g	g
Phenanthrene	27	11	U10	U10	g	g
Anthracene	E4	E2	U10	U10	g	g
Fluoranthene	16	10	U10	U10	3,980[c]	g
Pyrene	12	E7	U10	U10	g	g
Benzo(a)anthracene	U10	E2	U10	U10	g	g
Chrysene	U10	E2	U10	U10	g	g
Benzo(b+k)fluoranthenes	U10	2	U10	U10	g	g
Benzo(a)pyrene	U10	2	U10	U10	g	g
Dibenzofuran	17	11	U10	U10	g	g
Benzene	E7	E4	U5	U5	5,300[d]	g
2-Methylnaphthalene	14	U10	U10	U10	g	g
LPAH	E110	E69	U60	U60	g	g
HPAH	L98	E55	U90	U90	g	g

[a] This table lists only contaminants that were detected. All other analyzed contaminants were undetected at relatively low detection limits (see Appendix A).

[b] D = field duplicate.

[c] Concentration exceeds chronic criteria.

[d] Insufficient data to develop criteria. Value presented is the lowest observed effect level (LOEL).

[e] Hardness dependent criteria (100 mg/L used).

[f] The first value is for trivalent chromium (III) and the second value is for hexavalent chromium (VI).

[g] No criteria or toxicity thresholds are presented in the water quality documents.

E = Concentration listed is an estimated value.

L = Concentration is less than the maximum shown.

U = Chemical was undetected. Number shown is the analytical detection limit for the chemical.

5.0 SOURCE EVALUATIONS

Problem area identification and prioritization in the Everett Harbor project area was based on a series of chemical and biological indices (PTI and Tetra Tech 1988b). These indices were used to relate conditions at stations within the project area to reference conditions in relatively uncontaminated embayments of Puget Sound. Project areas with sediments that contained high concentrations of chemicals and exhibited adverse biological effects received a ranking of "high priority" for evaluation of contaminant sources and remedial actions.

In the following sections, available information on potential sources of contamination (e.g., CSOs, storm drains, groundwater, industrial facilities, wastewater treatment plants, etc.) and offshore sediment data were evaluated in order to link sources to problem areas in the receiving environment. Evaluations of potential sources were completed for the two problem areas (East Waterway and nearshore Port Gardner; Figure 12) identified in PTI and Tetra Tech (1988b). Evaluations of potential sources of contamination were also performed for the six individual problem stations (SR-05, SD-03, ES-03, OG-01, SD-01, and SR-07; Figure 12) that were located outside the two problem areas (PTI and Tetra Tech 1988b). Five main factors were considered in the evaluations:

- Proximity of the potential source to the problem station offshore
- Similarity of problem chemicals in onshore samples and offshore sediments (where chemical data for potential sources were available)
- Similarity of the relative percent distribution of chemicals within the drain and receiving environment sediments (where drain sediment data were available)

- The spatial distribution of contaminants in the offshore sediments
- Available information on past or ongoing practices that may have contributed to the contamination observed in the receiving environment.

5.1 PROBLEM AREAS

5.1.1 East Waterway Problem Area

A portion of the East Waterway was designated as a problem area primarily because of its scores for sediment chemistry, which averaged 58 percent of the maximum possible (PTI and Tetra Tech 1988b). The average score for biological indicators of contamination in the East Waterway was 20 percent of the maximum possible. The highest concentrations of most of the chemicals measured in the receiving environment study occurred at stations in this problem area, and the most severe sediment contamination was along the eastern shore (PTI and Tetra Tech 1988b).

The two chemicals that exceeded HAET concentrations most frequently in the East Waterway sediments were 4-methylphenol and LPAH. Other phenolic compounds, as well as HPAH, also exceeded HAET at certain East Waterway stations. The concentration of 4-methylphenol was highest at Station EW-07 (Figure 13), and elevated at all stations in the waterway. LPAH concentrations were highest at Stations EW-04, EW-07, EW-13 and EW-14, but were also elevated at most of the East Waterway stations. Naphthalene was the predominant PAH compound in the problem area (PTI and Tetra Tech 1988b).

Many compounds historically related to the pulp industry (e.g., resin acids, chlorinated phenols, chlorinated guaiacols) were found at elevated concentrations in the sediments of the East Waterway. Unchlorinated resin acids, which occur naturally in the resins and tissues of certain plants, are highly concentrated by pulping processes. Chlorinated resin acids, as well as chlorinated guaiacols, are useful geochemical tracers of pulp mill activities because they are generated during the chlorine bleaching process (PTI and Tetra Tech 1988b).

The two most prevalent resin acids in the project area, dehydroabietic acid (DHA) and abietic acid, were found at their highest observed concentrations at Stations EW-04 and EW-13 (Figure 13), respectively. The spatial distribution patterns of resin acid concentrations suggested that contamination at Stations EW-04 and EW-13 derived from distinct sources of a similar nature; however, chlorinated compounds were more prevalent at Station EW-04 than at Station EW-13. Concentrations of chlorinated resin acids, 2-chlorophenol, pentachlorophenol, 2-methyphenol, 2,4-dimethylphenol and several other compounds maximized at Station EW-04. Chlorinated phenols and chlorinated guaiacols had pronounced concentration maxima at Stations EW-01 and EW-02 (PTI and Tetra Tech 1988b).

Metals were not identified as problem chemicals in the sediments from the East Waterway as frequently as organic compounds. Copper and zinc were the only metals with concentrations that exceeded HAET, and both metals exceeded HAET concentration only at Station EW-14 (Figure 13). Zinc exceeded LAET concentration at several historical stations in the area [e.g., Stations BPS30 (Crecelius et al. 1984); E-04 (Battelle 1986); and PS05 (Storer and Arsenault 1987)]. Mercury exceeded LAET concentration at Station EW-10. Arsenic, cadmium, lead and mercury exceeded LAET concentrations at Station EW-14.

Drains as Potential Contaminant Sources--

During the onshore sampling effort for this study, four sediment samples were collected from three drains that discharge into the East Waterway problem area. Results from the chemical and physical analysis of these sediments appear in Appendix A, and are discussed in Section 4.0 of this report. The discussion below evaluates those drains, as well as other onshore facilities and activities, for their potential contributions to the chemical contamination measured in the sediments from the East Waterway.

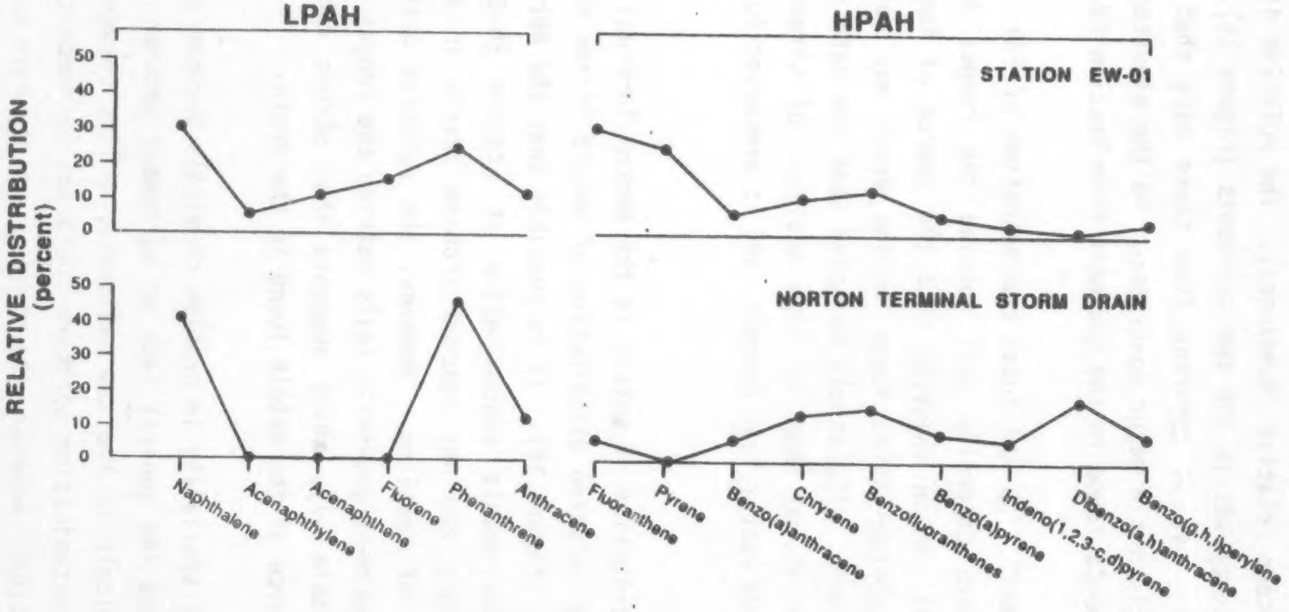

Figure 14. Comparison of relative percent distribution of PAH compounds in sediment from Station EW-01 and sediment from the Norton Terminal Storm Drain.

number of LPAH compounds detected in the drain sediment. The relative distributions of HPAH compounds in the two sediments are more similar, but there are still differences between the two [e.g., fluoranthene, pyrene, and dibenzo(a,h)anthracene relative abundances]. The relative distributions of the pulp industry compounds in the two sediments (Figure 15) also do not match each other well. It is apparent from these data that the Norton Terminal SD was probably not a major contributor to the elevated concentrations of organic compounds found in the sediment from Station EW-01.

The relative distribution and total concentration of PAH compounds in the drain sediment were generally well outside the ranges expected for street dust (Table 46), which suggests that the source of the relatively small amount of PAH contamination found in the drain may not have been solely from street runoff. (It should be noted that the data presented in Tables 46 and 47 for street dust is from analysis of street dust from Bellevue and Seattle, WA rather than Everett, and is presented for comparison purposes only).

The relative distribution of metals in the Norton Terminal SD sediment is very similar to the relative distribution of metals in the sediment from offshore Station EW-01 (Figure 16). It is possible that the Norton Terminal SD has contributed to metals contamination at Station EW-01, although concentrations of metals had not reached problem levels in the offshore sediment at the time of sampling. However, the relative distribution of metals in the drain sediment generally falls outside the ranges expected for urban street dust (Table 47), which suggests that street runoff may not have been the only source of the metals found in the drain.

Given the lack of similarity in problem chemicals between the drain and offshore sediments, and the general lack of agreement between the relative distributions of chemicals in the two sediments, a link between the Norton Terminal SD and the contamination offshore could not be demonstrated at the time of sample collection. However, the storm drain may have contributed to metals contamination offshore that had not reached problem levels at the time of sampling.

TABLE 47. RELATIVE PERCENT DISTRIBUTION OF METALS IN SEDIMENTS FROM DRAINS DISCHARGING INTO THE EAST WATERWAY

Metal	Norton Terminal Storm Drain	CSO E011 Manhole 1	CSO E011 Manhole 2	CSO E007	Street Dust[a]
Antimony	1.3	4.5	0.2	1.4	<1
Arsenic	2.9	0.8	0.2	1.1	1-5
Cadmium	0.15	0.1	0.2	0.1	<1
Chromium	29	44	1.7	28	2-15
Copper	15	3.9	2.0	7.8	4-12
Lead	7.9	9.8	3.7	29	30-64
Mercury	1.1	0.01	0.01	0.1	<1
Silver	0.08	0.02	0.03	0.06	<1
Zinc	43	37	92	32	14-54
Total metals (mg/kg)	463[b]	371[b]	10,753[b]	675[b]	650-1,800[c]

[a] Street dust samples collected from two industrial and two commercial areas in Seattle, WA.

[b] Values reported as dry-weight concentration.

[c] Street dust values reported as wet-weight concentration.

CSO E011-- CSO E011 is the CSO for Lift Station #5 in the City of Everett's sewer system. Sediment samples were collected from two manholes on the CSO line (see Figure 3). Sample E011-1 was collected from Manhole 1 (MH1), the manhole closest to the outfall. Sample E011-2 was collected from Manhole 2 (MH2), the next most upstream manhole (Tetra Tech 1986b). Both manholes are on Scott Paper Company property.

The outfall for CSO E011 is approximately 250 ft north of offshore Station EW-04 (see Figure 13). In the sediment from Station EW-04, LPAH (25,000 ug/kg), phenol (2,100 ug/kg), 2-methylphenol (1,200 ug/kg), 4-methylphenol (35,000 ug/kg), 2,4-dimethylphenol (520 ug/kg), benzyl alcohol (810 ug/kg), 1,2-dichlorobenzene (96 ug/kg), and PCBs (E9,600 ug/kg) were measured at concentrations that exceeded HAET. Fluoranthene (2,300 ug/kg) exceeded the LAET concentration, and 2-chlorophenol (160 ug/kg), 2,4-dichlorophenol (91 ug/kg), 2,3,4,6-tetrachlorophenol (78 ug/kg), pentachlorophenol (E460 ug/kg), abietic acid (52,000 ug/kg), isopimaric acid (E5,600 ug/kg), sandaracopimaric acid (8,800 ug/kg), 12-chlorodehydroabietic acid (11,000 ug/kg), and 14-chlorodehydroabietic acid (3,400 ug/kg) exceeded 90th percentile concentrations. DHA (83,000 ug/kg) exceeded an EAR of 1,000 in the sediment from Station EW-04 (PTI and Tetra Tech 1988b).

A similar group of problem chemicals was identified in the drain sediments from CSO E011. In drain sediment Sample E011-1, LPAH (8,190 ug/kg), acenaphthene (1,500 ug/kg), 4-methylphenol (3,300 ug/kg), and benzoic acid (2,400 ug/kg) exceeded HAET concentrations. In drain sediment Sample E011-2, napthalene (Z3,100 ug/kg), acenaphthylene (770 ug/kg), and dimethyl phthalate (250 ug/kg) exceeded HAET concentrations. Chemicals that exceeded LAET concentrations in Sample E011-1 or E011-2, or both, included various PAH compounds, total LPAH, total HPAH, and butylbenzyl phthalate.

Three contaminants identified as problem chemicals in the sediment from offshore Station EW-04 (benzyl alcohol, 2-methylphenol, and 2,4-dimethylphenol) were undetected in samples E011-1 and E011-2, but were undetected at detection limits that exceeded HAET (see Table 44). It is possible that these three compounds were present in the drain sediments at concentrations that exceeded HAET.

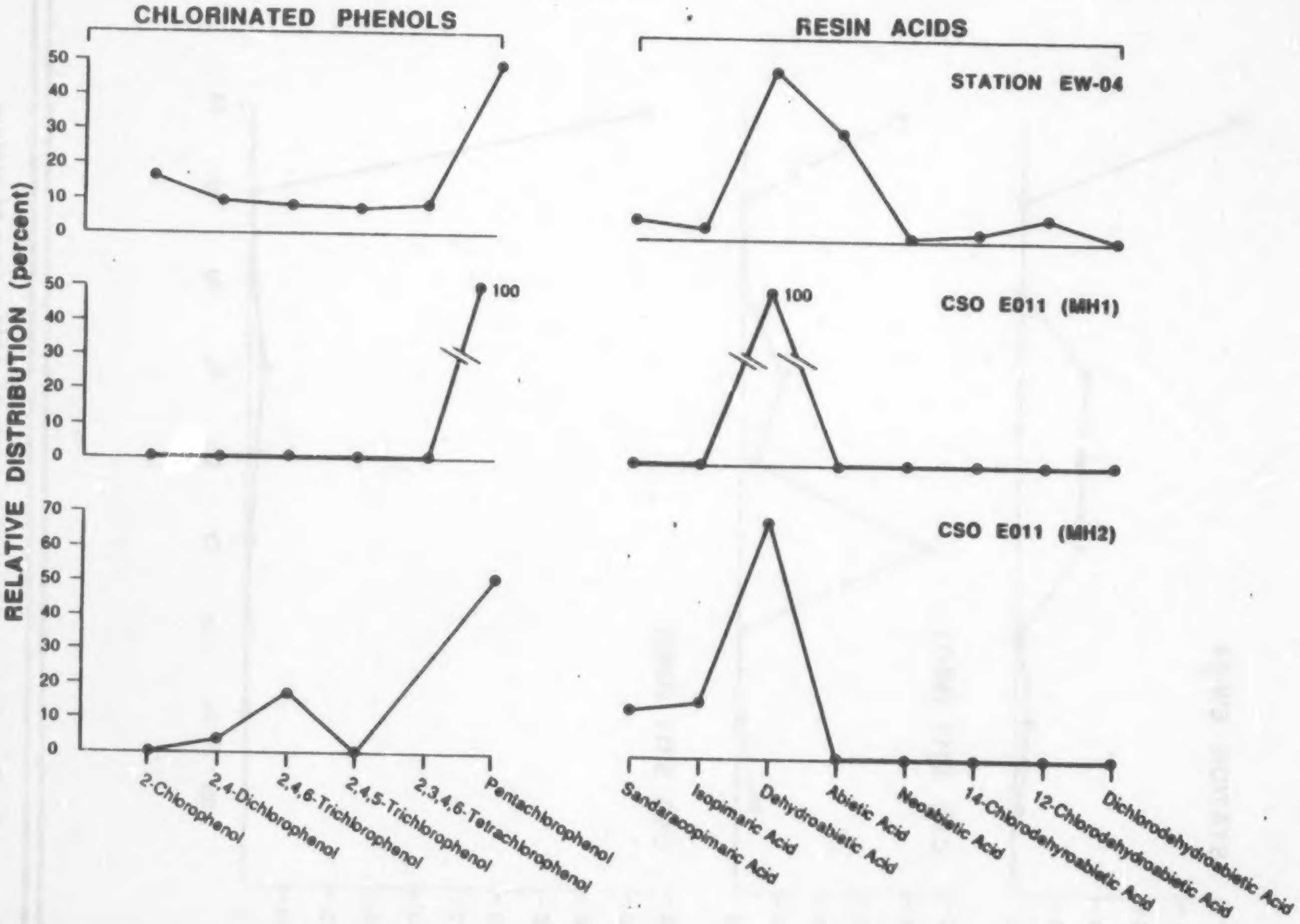

Figure 17. Comparison of relative percent distribution of pulp industry compounds in sediment from Station EW-04 and sediment from two locations along CSO E011.

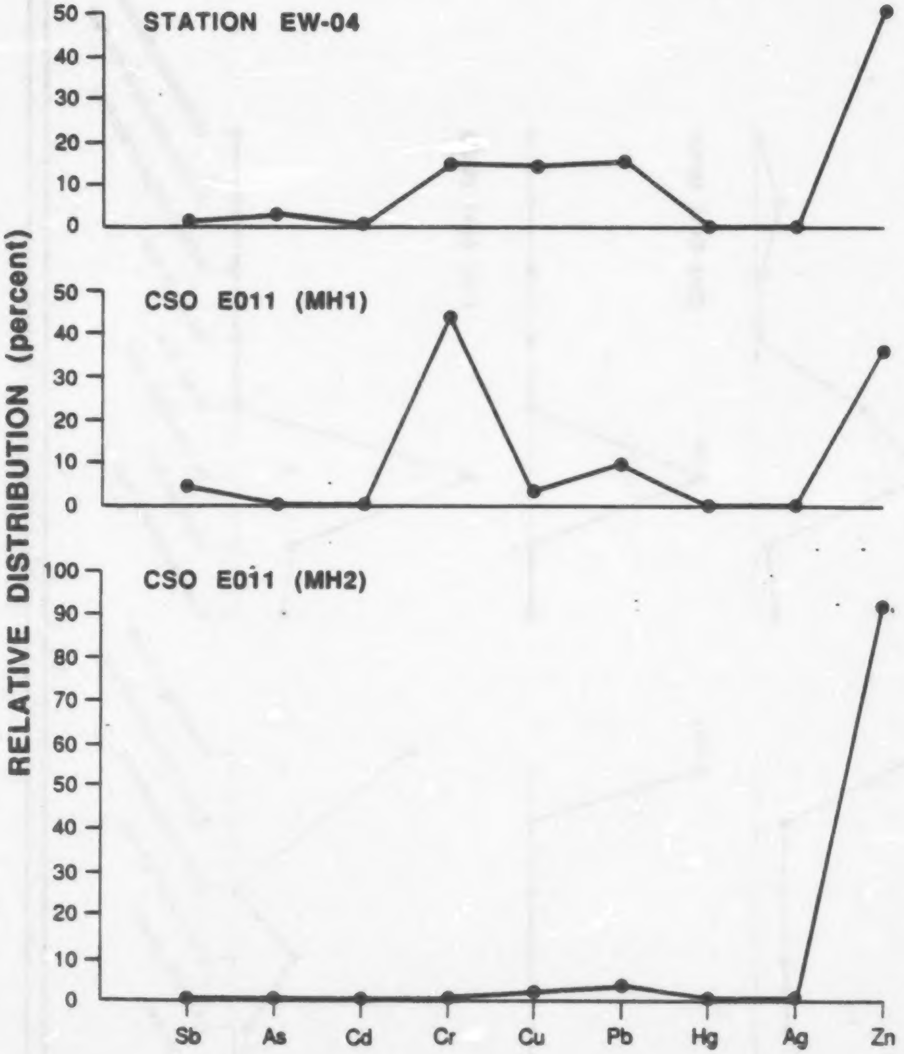

Figure 19. Comparison of relative percent distribution of metals in sediment from Station EW-04 and sediment from two locations along CSO E011.

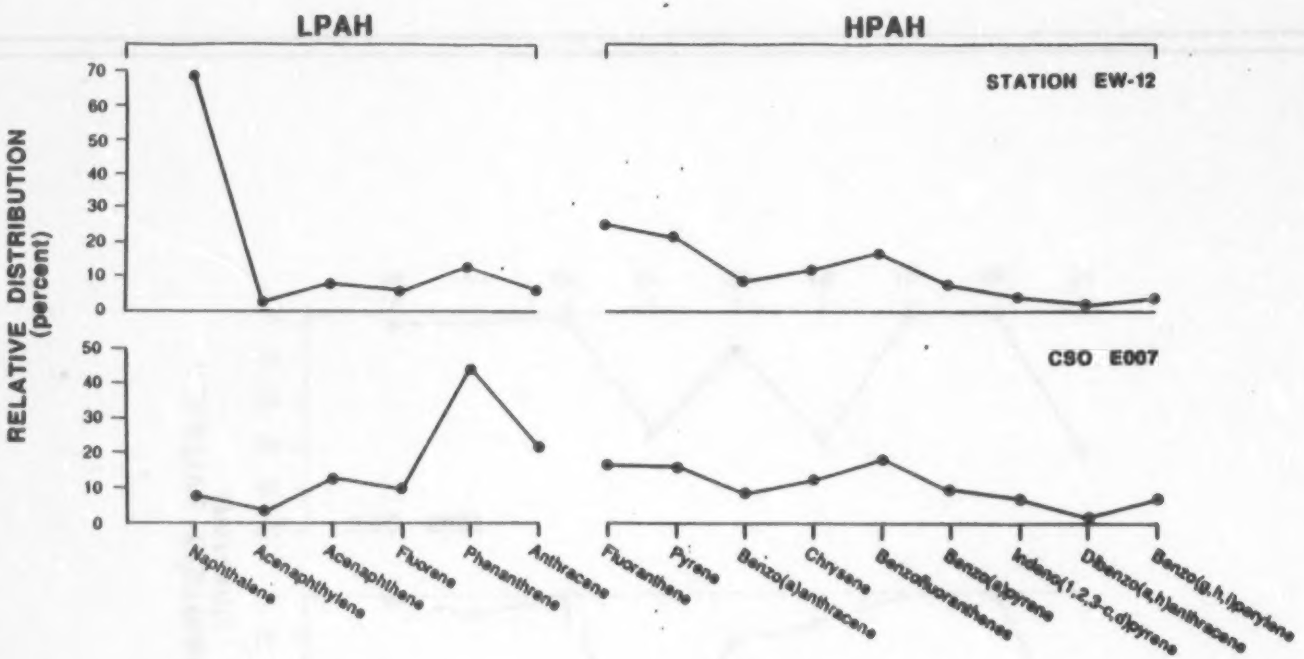

Figure 20. Comparison of relative percent distribution of PAH compounds in sediment from Station EW-12 and sediment from CSO E007.

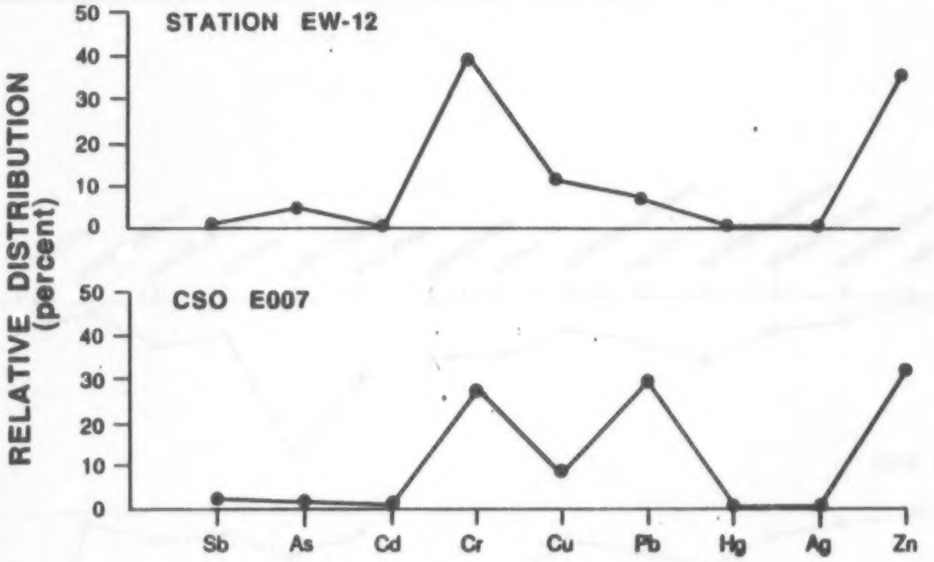

Figure 21. Comparison of relative percent distribution of metals in sediment from Station EW-12 and sediment from CSO E007.

In 1975, the sulfite mill was converted to a thermomechanical plant in an effort to reduce pollutant loadings from the mill. At that time, Outfalls WT002 and WT003 were sealed and abandoned, and discharges from Outfalls WT004 and WT006 were limited to stormwater runoff from areas not involved with the pulping process. All process wastes were treated at the newly built secondary treatment plant before being discharged through the deepwater diffuser. The thermomechanical mill was closed permanently in 1980 (Tetra Tech 1985b). Few data are available for loadings of pollutants discharged from these outfalls other than conventional variables, such as BOD and TSS.

Another widespread contaminant found in sediments collected from the East Waterway was 4-methylphenol. 4-Methylphenol is used in phenolic resins, in magnet wire, as a plasticizer in fire retardants, and in an antioxidant, butylated hydroxytoluene (Burch, W., 1 September 1987, personal communication). No specific sources of 4-methylphenol in the East Waterway area have been identified, other than the contamination found in CSO E011.

Concentrations of LPAH and to a lesser extent, HPAH, were also elevated in most areas of the East Waterway. PAH compounds are found in fossil fuels and petroleum-related materials, including coal tar creosote, which is used to protect wood from decay (Merck 1983). The large number of treated wood pilings in the East Waterway area that form docks, piers, and related structures may be a source of PAH compounds. Additionally, shipping industry vessels and their related fuels and oils might be a source of this contamination. LPAH compounds are characteristic of unburned fossil fuels, and HPAH compounds are characteristic of combusted fuel material (Lee et al. 1977).

Summary--

The sediment contamination in the East Waterway apparently originates from several sources. At least one CSO (E011) has probably contributed to the PAH and 4-methylphenol contamination offshore. Historical and current pulp industry activities may have contributed chlorinated phenolic compounds and resin acids to the sediment offshore. Additional sampling of area CSOs, are discussed in Section 4.0 of this report. The discussion below evaluates those samples, as well as other onshore facilities and activities, for their potential contributions to the chemical contamination found in the sediments from the nearshore Port Gardner problem area.

The four groundwater samples contained few of the target chemicals listed in Table 42 (see Section 3.2.3), and the few chemicals detected were generally at relatively low concentrations. Only a few metals exceeded U.S. EPA freshwater quality criteria for chronic effects (see Table 45). A few PAH compounds were found at low concentrations (less than 30 ug/L) in the sample from monitoring Well 4 (and its field replicate). The problem chemicals identified in the sediments from the nearshore Port Gardner area, especially 4-methylphenol, benzoic acid, phenol, and PCBs, were generally undetected in the groundwater samples at low detection limits (typically 10 ug/L). Based on the dissimilarity between the problem chemicals found in the sediments offshore of Port Gardner and those found in the groundwater samples, a link between the groundwater beneath the fuel supply depot and the contamination found in the sediment offshore could not be demonstrated at the time the groundwater samples were collected. However, as discussed in Section 4.2, sampling personnel observed that groundwater samples from at least two of the monitoring wells were contaminated with one or more oily substances (Tetra Tech 1986b). Since laboratory analyses for specific fuels or other petroleum-related materials were not performed these samples, it is not possible to evaluate the nature or amount of this oily contaminant, or its effects offshore.

Other Potential Sources of Contamination--

The two major facilities along the shoreline of the nearshore Port Gardner problem area are the Mulkilteo WWTP and the Mulkilteo Defense Fuel Supply Depot (see Figure 6). The WWTP is discussed in Section 2.2.

The fuel depot has several discharge outfalls along shoreline of Port Gardner (see Figures 2 and 6) (see Sections 2.1 and 2.6 of this report). Outfalls 1 through 5 are for stormwater and fuel condensate. Outfall 6 discharges stormwater and wastewater from the fuels laboratory onsite

1988b). These chemicals have varying degrees of association with the pulp industry.

Although such chemicals could have been transported from the East Waterway, the following evidence suggests that the source of the contamination is closer to Station OG-01:

- Concentrations are spatially uniform in the area, and do not clearly decrease with distance from the East Waterway

- Examination of chemical contamination along a transect from Station EW-15 (at the mouth of the East Waterway) to nearby Station NG-01 to Station OG-01 (further away from EW-15) reveals that concentrations of several diagnostic compounds, such as 4-methylphenol and naphthalene, decrease from Station EW-15 to Station NG-01 and then increase at Station OG-01 (resin acids were not measured at Stations NG-01 and OG-01)

- Contamination patterns within the East Waterway (i.e., prominent concentration maxima for certain chemicals) do not suggest the presence of strong advection processes (PTI and Tetra Tech 1988b).

Station OG-01 was located near the SW001 outfall diffuser (see Figures 2 and 12) currently used by the Scott Paper Company. Scott uses the outfall to discharge effluent from its primary clarifiers (see Section 5.1.1). Before their thermomechanical pulp mill closed in 1980, Weyerhaeuser discharged a variety of effluents through this outfall, including untreated sulfite waste liquor and effluent from a secondary treatment plant (Tetra Tech 1985b). These discharges from Outfall SW001 probably were the source of the resin acids found in the area around Station OG-01. Specific sources of the 4-methylphenol and PAH contamination found in the area have not been identified.

well as stormwater runoff from the mill area, into an aerated lagoon system on Smith Island. Effluent from these lagoons is discharged to Steamboat Slough through Outfall WK001, located on the northwestern side of Smith Island (Tetra Tech 1985b). Because of the distance involved, Outfall WK001 was probably not a major contributor to the contamination at Station SR-05. Few data are available on the specific chemicals found in the other discharges. Weyerhaueser reported in its 1983 permit application that cresol (a methyl phenol) would be present in effluent from all the outfalls (Tetra Tech 1985b). Specific sources of benzoic acid in the area have not been identified.

5.2.4 Problem Station ES-03

Station ES-03 was located in Ebey Slough, just southeast of the mouth of Quilceda Creek (see Figure 12). Benzoic acid (E760 ug/kg) and 4-methylphenol (1,400 ug/kg) concentrations exceeded HAET at this station. Phenol (Z1,200 ug/kg) exceeded the LAET concentration at Station ES-03. Concentrations of benzoic acid and 4-methylphenol at Station ES-02 (upriver) were at least 30 times lower than at Station ES-03 (PTI and Tetra Tech 1988b).

A potential source of the benzoic acid and phenol observed at Station ES-03 may have been the Tulalip landfill (see Figure 2). The landfill is located in an estuarine-tidal action area. Normal tidal action submerges at least part of the site, and would thus allow leachate to be released to the offshore environment. In the past, benzoic acid and phenol have been detected in leachate samples from the landfill (Ecology & Environment 1984).

The 4-methylphenol contamination at Station ES-03 may be associated with the various wood waste and treating facilities throughout the Snohomish River and its sloughs. Buse Timber, located on Union Slough, and the Weyerhaeuser Kraft mill outfall (WK001) on Steamboat Slough, are the nearest wood products facilities to Station ES-03 (see Figure 2). However, sediments collected from Stations SS-03, SS-04, and SS-05 in Steamboat Slough, immediately offshore of Outfall WK001 (see Figures 2 and 10), contained 4-methylphenol at concentrations (17-1,100 ug/kg) lower than those observed the physical environment rather than chemical contamination (PTI and Tetra Tech 1988b).

CSOs, storm drains, natural drainages (e.g., creeks), and industrial discharges in the project area.

Additional sediment and water samples from CSOs are needed because of the complexity of the CSO system. The many overflow weirs, regulators, and pumping stations make it difficult to identify sources of specific chemicals within a drainage basin. A monitoring approach similar to the one proposed in Tetra Tech (1988a), combined with information on the activities and practices of industries within the drainage basins, would make it possible to screen drainage basins for chemical contamination and trace a contaminant to its ultimate source.

Sediment and water samples from city and private storm drains are needed because a large number of these drains near problem stations have not been characterized. Sediment and water samples from area creeks are needed because some of these natural drainages serve industrialized areas and have not been investigated. Further characterization of the effluents being discharged from the local industrial facilities, particularly those involved with pulping activities, would help define the contamination caused by historical rather than ongoing activities.

Results from a U.S. EPA field investigation of the Tulalip landfill were published in July 1988 but were not made available to the public in time for inclusion in this document. Results from an Ecology study of Paine Field and its drainages are expected to be published in October 1988 (Johnson, A., 16 August 1988, personal communication). In addition, the City of Everett continues to monitor both water quality and quantity in selected CSOs during rainfall events. These data will help determine potential sources of contamination in the project area, while the sampling discussed above will be needed to eliminate the remaining data gaps. The need for this additional sampling should be taken into account when revising the Everett Harbor Action Plan.

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APPENDIX A

PHYSICAL AND CHEMICAL DATA FOR THE DRAINS AND GROUNDWATER SAMPLES COLLECTED DURING THE EVERETT HARBOR ACTION PROGRAM SOURCE INVESTIGATION

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PHYSICAL AND CHEMICAL DATA FOR THE DRAINS AND GROUNDWATER SAMPLES COLLECTED DURING EVERETT HARBOR ACTION PROGRAM

Chemical data collected in support of the Everett Harbor Action Program during 15-29 October 1986 are presented in this appendix. Data qualifiers were used to describe, clarify, or explain data values. A complete list of data qualifiers used in the Everett Harbor Action Program is provided below:

- U = The compound or element was not detected at the detection limit shown. Detection limits are generally defined as the lowest measurable concentration reliably detectable by a particular method.
- E = The reported concentration is an estimate. The estimated qualifier was assigned for a variety of reasons including exceedance of control limits for calibration, precision, accuracy, and holding times.
- B = Concentration was corrected for blank contribution. Blank contribution was greater than or equal to the sample value, therefore reported value is the detection limit.
- Z = Concentration was corrected for blank contribution. Value still exceeds the detection limit.
- X = This qualifier was assigned if the labeled internal standard recovery reported by the laboratory was less than 10 percent.
- L = This qualifier indicates that the value is less than the maximum shown. An "L" qualifier was applied to a group sum because analytical detection limits for undetected compounds were included in the summation of representative compounds within a chemical group.

TABLE A-1. EVERETT HARBOR SOURCE SAMPLING LOCATIONS

DRAIN SEDIMENT STATIONS

Station	Drainage	Location	East Coord.	North Coord.
E007	17110019-EW-007	24 S. Bond St. CSO (E007)	1660670	359690
E011-1	17110019-EW-011	Lift Station #5 CSO (E011) - Manhole 1	1661145	362230
E011-2	17110019-EW-011	Lift Station #5 CSO (E011) - Manhole 2	1661350	362235
NORT	17110019-EW-042	Norton Terminal Storm Drain	1661380	364320

GROUNDWATER STATIONS

Station	Drainage	Location	East Coord.	North Coord.
MUK4	17110019-NG-004	Mukilteo defense fuel supply, near NE corner of Tank 10	1643270	350730
MUK8	17110019-NG-008	Mukilteo defense fuel supply, between Tanks 8 and 9	1642760	350495
MUK12	17110019-NG-012	Mukilteo defense fuel supply, east of Tank 10	1643350	350740

TABLE A-3. CONCENTRATIONS OF VOLATILE COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: HALOGENATED ALKANES I

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	chloromethane	bromomethane	chloroethane	1,1-dichloroethane	chloroform	1,2-dichloroethane
E007		10/15/86	U8	U8	U8	U4	U4	U4
E011-1		10/29/86	U7	U7	U7	U3	U3	U3
E011-2		10/29/86	U16	U16	U16	U8	31	U8
NORT		10/15/86	U15	U15	U15	U8	U8	U8

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	chloromethane	bromomethane	chloroethane	1,1-dichloroethane	chloroform	1,2-dichloroethane
MUK4	1	10/16/86	U50	U50	U50	U25	U25	U25
MUK4	2F	10/16/86	U25	U25	U25	U13	U13	U13
MUK4	Mean	10/16/86	U25	U25	U25	U13	U13	U13
MUK8		10/16/86	U10	U10	U10	U5	U5	U5
MUK12		10/16/86	U10	U10	U10	U5	U5	U5

TABLE A-4. (CONTINUED)

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	1,1,1-trichloroethane	carbon tetrachloride	bromodichloromethane	1,2-dichloropropane	dibromochloromethane	1,1,2-trichloroethane
MUK4	1	10/16/86	U25	U25	U25	U25	U25	U25
MUK4	2F	10/16/86	U13	U13	U13	U13	U13	U13
MUK4	Mean	10/16/86	U13	U13	U13	U13	U13	U13
MUK8		10/16/86	U5	U5	U5	U5	U5	U5
MUK12		10/16/86	U5	U5	U5	U5	U5	U5

Station	Rep	Sampling Date	bromoform	1,1,2,2-tetrachloroethane
MUK4	1	10/16/86	U25	U25
MUK4	2F	10/16/86	U13	U13
MUK4	Mean	10/16/86	U13	U13
MUK8		10/16/86	U5	U5
MUK12		10/16/86	U5	U5

TABLE A-6. CONCENTRATIONS OF VOLATILE COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: AROMATIC HYDROCARBONS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	benzene	toluene	ethyl-benzene	styrene	total xylenes
E007		10/15/86	U4	U4	U4	U4	U4
E011-1		10/29/86	U3	U3	U3	U3	U3
E011-2		10/29/86	U8	U8	U8	U8	U8
NORT		10/15/86	U8	U8	U8	U8	2

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	benzene	toluene	ethyl-benzene	styrene	total xylenes
MUK4	1	10/16/86	E7	U25	U25	U25	U25
MUK4	2F	10/16/86	E4	U13	U13	U13	U13
MUK4	Mean	10/16/86	E6	U13	U13	U13	U13
MUK8		10/16/86	U5	U5	U5	U5	U5
MUK12		10/16/86	U5	U5	U5	U5	U5

TABLE A-8. CONCENTRATIONS OF VOLATILE COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: ETHERS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	2-chloro-ethyl-vinyl-ether
E007		10/15/86	U8
E011-1		10/29/86	U7
E011-2		10/29/86	U16
NORT		10/15/86	U15

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	2-chloro-ethyl-vinyl-ether
MUK4	1	10/16/86	U50
MUK4	2F	10/16/86	U25
MUK4	Mean	10/16/86	U25
MUK8		10/16/86	U10
MUK12		10/16/86	U10

TABLE A-10. CONCENTRATIONS OF VOLATILE COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: MISCELLANEOUS VOLATILE COMPOUNDS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	carbon di-sulfide	vinyl acetate
E007		10/15/86	U4	U8
E011-1		10/29/86	U3	U7
E011-2		10/29/86	U8	U16
NORT		10/15/86	U8	U15

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	carbon di-sulfide	vinyl acetate
MUK4	1	10/16/86	U25	U50
MUK4	2F	10/16/86	U13	U25
MUK4	Mean	10/16/86	U13	U25
MUK8		10/16/86	U5	U10
MUK12		10/16/86	U5	U10

TABLE A-12. CONCENTRATIONS OF EXTRACTABLE ORGANIC COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: SUBSTITUTED PHENOLS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	2-nitrophenol	2,4-dinitrophenol	4,6-dinitro-2-methylphenol	4-nitrophenol	4-chloro-3-methylphenol
E007		10/15/86	U50	U50	U100	U50	U50
E011-1		10/29/86	U50	U50	U100	U50	U50
E011-2		10/29/86	U50	U50	U100	U50	U50
NORT		10/15/86	U50	U50	U100	U50	U50

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	2-chlorophenol	2,4-dichlorophenol	4-chloro-3-methylphenol	2,4,6-trichlorophenol	2,4,5-trichlorophenol	pentachlorophenol
MUK4	1	10/16/86	U10	U10	U10	U10	U50	U50
MUK4	2F	10/16/86	U10	U10	U10	U10	U50	U50
MUK4	Mean	10/16/86	U10	U10	U10	U10	U50	U50
MUK8		10/16/86	U10	U10	U10	U10	U50	U50
MUK12		10/16/86	U10	U10	U10	U10	U50	U50

Station	Rep	Sampling Date	2-nitrophenol	2,4-dinitrophenol	4,6-dinitro-2-methylphenol	4-nitrophenol
MUK4	1	10/16/86	U10	U50	U50	U50
MUK4	2F	10/16/86	U10	U50	U50	U50
MUK4	Mean	10/16/86	U10	U50	U50	U50
MUK8		10/16/86	U10	U50	U50	U50
MUK12		10/16/86	U10	U50	U50	U50

TABLE A-14. CONCENTRATIONS OF EXTRACTABLE ORGANIC COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: HIGH MOLECULAR WEIGHT POLYAROMATIC HYDROCARBONS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	fluor-anthene	pyrene	benzo-(a)-anthra-cene	chrysene	benzo-(a)-pyrene	indeno-(1,2,3-cd)-pyrene
E007		10/15/86	940	Z930	450	730	570	390
E011-1		10/29/86	4600	Z5000	960	1100	540	270
E011-2		10/29/86	1300	Z1100	270	420	220	170
NORT		10/15/86	12	810	4	8	5	4

Station	Rep	Sampling Date	di-benzo-(a,h)-anthra-cene	benzo-(g,h,i)-perylene	benzo-(B+K) fluoran-thenes
E007		10/15/86	110	390	E990
E011-1		10/29/86	79	320	E1000
E011-2		10/29/86	42	210	E550
NORT		10/15/86	10	5	E9

TABLE A-15. CONCENTRATIONS OF EXTRACTABLE ORGANIC COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: CHLORINATED AROMATIC HYDROCARBONS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	1,3-dichloro-benzene	1,4-dichloro-benzene	1,2-dichloro-benzene	1,2,4-tri-chloro-benzene	2-chloro-naphtha-lene	hexa-chloro-benzene
E007		10/15/86	5	51	42	U10	U50	U20
E011-1		10/29/86	U500	X92	U500	U200	U50	U50
E011-2		10/29/86	X65	X190	U50	U10	U50	U50
NORT		10/15/86	U10	10	U10	U200	U50	U50

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	1,3-dichloro-benzene	1,4-dichloro-benzene	1,2-dichloro-benzene	1,2,4-tri-chloro-benzene	2-chloro-naphtha-lene	hexa-chloro-benzene
MUK4	1	10/16/86	U10	U10	U10	U10	U10	U10
MUK4	2F	10/16/86	U10	U10	U10	U10	U10	U10
MUK4	Mean	10/16/86	U10	U10	U10	U10	U10	U10
MUK8		10/16/86	U10	U10	U10	U10	U10	U10
MUK12		10/16/86	U10	U10	U10	U10	U10	U10

TABLE A-17. CONCENTRATIONS OF EXTRACTABLE ORGANIC COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: HALOGENATED ETHERS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	bis(2-chloro-ethyl) ether	bis(2-chloro-isopropyl) ether	bis(2-chloro-ethoxy) methane	4-chloro-phenyl-phenyl-ether	4-bromo-phenyl-phenyl-ether
E007		10/15/86	U20	U10	U10	U10	U10
E011-1		10/29/86	U20	U10	U10	U10	U10
E011-2		10/29/86	U20	U10	U10	U10	U10
NORT		10/15/86	U20	U10	U10	U10	U10

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	bis(2-chloro-ethyl) ether	bis(2-chloro-isopropyl) ether	bis(2-chloro-ethoxy) methane	4-chloro-phenyl-phenyl-ether	4-bromo-phenyl-phenyl-ether
MUK4	1	10/16/86	U10	U10	U10	U10	U10
MUK4	2F	10/16/86	U10	U10	U10	U10	U10
MUK4	Mean	10/16/86	U10	U10	U10	U10	U10
MUK8		10/16/86	U10	U10	U10	U10	U10
MUK12		10/16/86	U10	U10	U10	U10	U10

TABLE A-19. CONCENTRATIONS OF EXTRACTABLE ORGANIC COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: MISCELLANEOUS OXYGENATED COMPOUNDS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	iso-phorone	benzyl alcohol	benzoic acid	dibenzo-furan
E007		10/15/86	U50	U20	400	170
E011-1		10/29/86	U50	U200	2400	1300
E011-2		10/29/86	U50	U200	U800	680
NORT		10/15/86	U50	U200	E6	3

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	iso-phorone	benzyl alcohol	benzoic acid	dibenzo-furan
MUK4	1	10/16/86	U10	U10	U50	17
MUK4	2F	10/16/86	U10	U10	U50	11
MUK4	Mean	10/16/86	U10	U10	U50	14
MUK8		10/16/86	U10	U10	U50	U10
MUK12		10/16/86	U10	U10	U50	U10

TABLE A-20. (CONTINUED)

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	nitrobenzene	n-nitroso-di-n-propylamine	4-chloroaniline	2-chloroaniline	3-chloroaniline	4-nitroaniline
MUK4	1	10/16/86	U10	U10	U10	U50	U50	U50
MUK4	2F	10/16/86	U10	U10	U10	U50	U50	U50
MUK4	Mean	10/16/86	U10	U10	U10	U50	U50	U50
MUK8		10/16/86	U10	U10	U10	U50	U50	U50
MUK12		10/16/86	U10	U10	U10	U50	U50	U50

Station	Rep	Sampling Date	2,6-dinitrotoluene	2,4-dinitrotoluene	n-nitrosodi-phenylamine	3,3'di-chlorobenzidine
MUK4	1	10/16/86	U10	U10	U10	U20
MUK4	2F	10/16/86	U10	U10	U10	U20
MUK4	Mean	10/16/86	U10	U10	U10	U20
MUK8		10/16/86	U10	U10	U10	U20
MUK12		10/16/86	U10	U10	U10	U20

TABLE A-22. CONCENTRATIONS (UG/KG DRY WEIGHT) OF RESIN ACID COMPOUNDS IN EVERETT HARBOR DRAIN SEDIMENTS

Station	Rep	Sampling Date	sandaracopimaric acid	isopimaric acid	dehydroabietic acid	abietic acid	neoabietic acid
E007		10/15/86	E69	E170	790	660	U200
E011-1		10/29/86	U150	U150	E29	U150	U150
E011-2		10/29/86	E140	E170	700	U290	U290
NORT		10/15/86	E390	E1600	4800	U340	U340

Station	Rep	Sampling Date	14-chlorodehydroabietic acid	12-chlorodehydroabietic acid	dichlorodehydroabietic acid
E007		10/15/86	U200	U200	U200
E011-1		10/29/86	U150	U150	U150
E011-2		10/29/86	U290	U290	U290
NORT		10/15/86	U340	U340	U340

TABLE A-24. CONCENTRATIONS OF EXTRACTABLE ORGANIC COMPOUNDS IN EVERETT HARBOR SOURCE SAMPLES: GROUP SUMS

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	low molecular weight aromatic hydrocarbons	high molecular weight aromatic hydrocarbons	total benzofluoranthenes
E007		10/15/86	Z1800	Z5500	990
E011-1		10/29/86	Z8200	L14000	1000
E011-2		10/29/86	Z5800	Z4300	550
NORT		10/15/86	L56	L67	9

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	low molecular weight aromatic hydrocarbons	high molecular weight aromatic hydrocarbons	total benzofluoranthenes
MUK4	1	10/16/86	E110	L98	U10
MUK4	2F	10/16/86	E69	L55	E2
MUK4	Mean	10/16/86	E88	L77	E2
MUK8		10/16/86	U60	U90	U10
MUK12		10/16/86	U60	U90	U10

TABLE A-26. CONCENTRATIONS OF PESTICIDES IN EVERETT HARBOR SOURCE SAMPLES

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	p,p'-DDE	p,p'-DDD	p,p'-DDT	aldrin	dieldrin	chlordane
E007		10/15/86	U1.0	U1.0	26	U5.0	13	U50
E011-1		10/29/86	U10	U10	U10	U5.0	U10	U50
E011-2		10/29/86	U10	U10	U10	U5.0	U10	U500
NORT		10/15/86	U1.0	U1.0	U1.0	U0.50	U1.0	U5.0

Station	Rep	Sampling Date	alpha-HCH	beta-HCH	delta-HCH	gamma-HCH (lindane)	alpha-endosulfan	beta-endosulfan
E007		10/15/86	U5.0	U5.0	U5.0	U5.0	U5.0	U1.0
E011-1		10/29/86	U5.0	U5.0	U5.0	U5.0	U5.0	U10
E011-2		10/29/86	U50	U50	U5.0	U50	U5.0	U10
NORT		10/15/86	U0.50	U0.50	U0.50	U0.50	U0.50	U1.0

Station	Rep	Sampling Date	endosulfan sulfate	endrin	heptachlor	heptachlor epoxide	toxaphene	endrin ketone	methoxychlor
E007		10/15/86	U10	U1.0	U5.0	U5.0	U100	U10	U50
E011-1		10/29/86	U10	U10	U5.0	U5.0	U100	U10	U50
E011-2		10/29/86	U10	U10	U50	U5.0	U100	U10	U50
NORT		10/15/86	U1.0	U1.0	U0.50	U0.50	U10	U1.0	U5.0

TABLE A-27. CONCENTRATIONS OF POLYCHLORINATED BIPHENYLS IN EVERETT HARBOR SOURCE SAMPLES

DRAIN SEDIMENTS (ug/kg DRY WEIGHT)

Station	Rep	Sampling Date	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs
E007		10/15/86								E220
E011-1		10/29/86								U50
E011-2		10/29/86								U50
NORT		10/15/86								U50

GROUNDWATER (ug/L)

Station	Rep	Sampling Date	Aroclor 1016	Aroclor 1221	Aroclor 1232	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260	Total PCBs
MUK4		10/16/86	U0.50	U0.50	U0.50	U0.50	U0.50	U0.50	U1.00	
MUK8		10/16/86	U0.50	U0.50	U0.50	U0.50	U0.50	U0.50	U1.00	
MUK12		10/16/86	U0.50	U0.50	U0.50	U0.50	U0.50	U0.50	U1.00	

APPENDIX B

POTENTIAL CONTAMINANT SOURCES IDENTIFIED IN THE EVERETT HARBOR PROJECT AREA

APPENDIX B

POTENTIAL CONTAMINANT SOURCES IDENTIFIED IN THE EVERETT HARBOR PROJECT AREA

EAST WATERWAY (EW)

- Scott Pulp and Paper Company, 26th Street and Federal Avenue
  - Nearshore diffuser S003
  - Secondary treatment plant outfall S008
  - S002 (historical)
  - Storm drains
- Port of Everett
  - Hewitt Terminal Piers 1 and 3
  - Pacific Terminal Piers B, D, and E
  - South Terminal - Weyerhaeuser Sulfite/Thermomechanical Plant (closed)
  - Storm drains
- Anaconda aluminum dome
- Everett Cold Storage (American Ice & Cold Storage), 2815 Federal Avenue
- Mobil Oil Co. (Johnston Petroleum Products), 2731 Federal Avenue
- Foss Tug, Port of Everett (between Pier B and Pier D)
- Dunlap log yard
- Dunlap Towing, 2702 Federal Avenue
- Western Gear (closed), 2100 Norton Avenue
- U.S. Naval Reserve
- TAT, USA Corp. log yard
- CSOs (City of Everett)
- Storm drains (City of Everett)

OFFSHORE PORT GARDNER (OG)

- Scott-Weyerhaeuser deepwater diffuser SW001

Fisherman's Boat Shop, 949 - 14th Street
Everett Bayside Marine, 1001 - 14th Street
Performance Marine, 1130 West Marine Drive
Individual boat owners

Storm drains

Steuart Seafoods, 1520 West Marine View Drive

American Boiler Works, 1332 West Marine Drive

Tri-Coatings (Marpac), Inc., 1104 - 10th Street

Centrecon, 1130 West Marine View Drive

Norton Terminal

Log storage yards

Buse Timber, 3812 - 28th Place NE

Canyon Lumber, 3821 - 26th Place

E.A. Nord Co., 300 West Marine View Drive

Bay Wood Products, 200 West Marine View Drive

Pacific Plating, 2421 Hewitt Avenue

Custom Pacific Plating, 2421 Hewitt Avenue

Truckcare, 2730 Harrison

EBEY SLOUGH (ES)

Marysville storm drains

Marysville WWTP

Boeing test facility, Tulalip Indian Reservation

Tulalip Landfill

Quilceda Creek

Allen Creek

STEAMBOAT SLOUGH (SS)

Tulalip Landfill

APPENDIX C

NPDES-PERMITTED DISCHARGERS AND CITY OF EVERETT INDUSTRIAL PRETREATMENT PERMITTED FACILITIES

APPENDIX C

NPDES-PERMITTED INDUSTRIAL DISCHARGERS AND CITY OF EVERETT INDUSTRIAL PRETREATMENT PERMITTED FACILITIES

NPDES-PERMITTED INDUSTRIAL DISCHARGERS

Defense Fuel Support Point - Mukilteo
Scott Pulp and Paper Co.
Weyerhaeuser Everett Kraft Mill

CITY OF EVERETT INDUSTRIAL PRETREATMENT PERMITTED FACILITIES

Boeing Commercial Airplane Co.
Centrecon
Custom Pacific Plating
John Fluke Mfg. Co. - Seaway Blvd.
John Fluke Mfg. Co. - Evergreen Way
Kohkoku (USA), Inc.
Pacific Plating
Cathcart Landfill
Stewart Seafood
Tri-Coatings, Inc. (Marpac)

APPENDIX D

GRAIN SIZE CHARACTERISTICS OF THE SEDIMENTS IN THE DRAINS AND OFFSHORE RECEIVING ENVIRONMENT IN THE EAST WATERWAY STUDY AREA

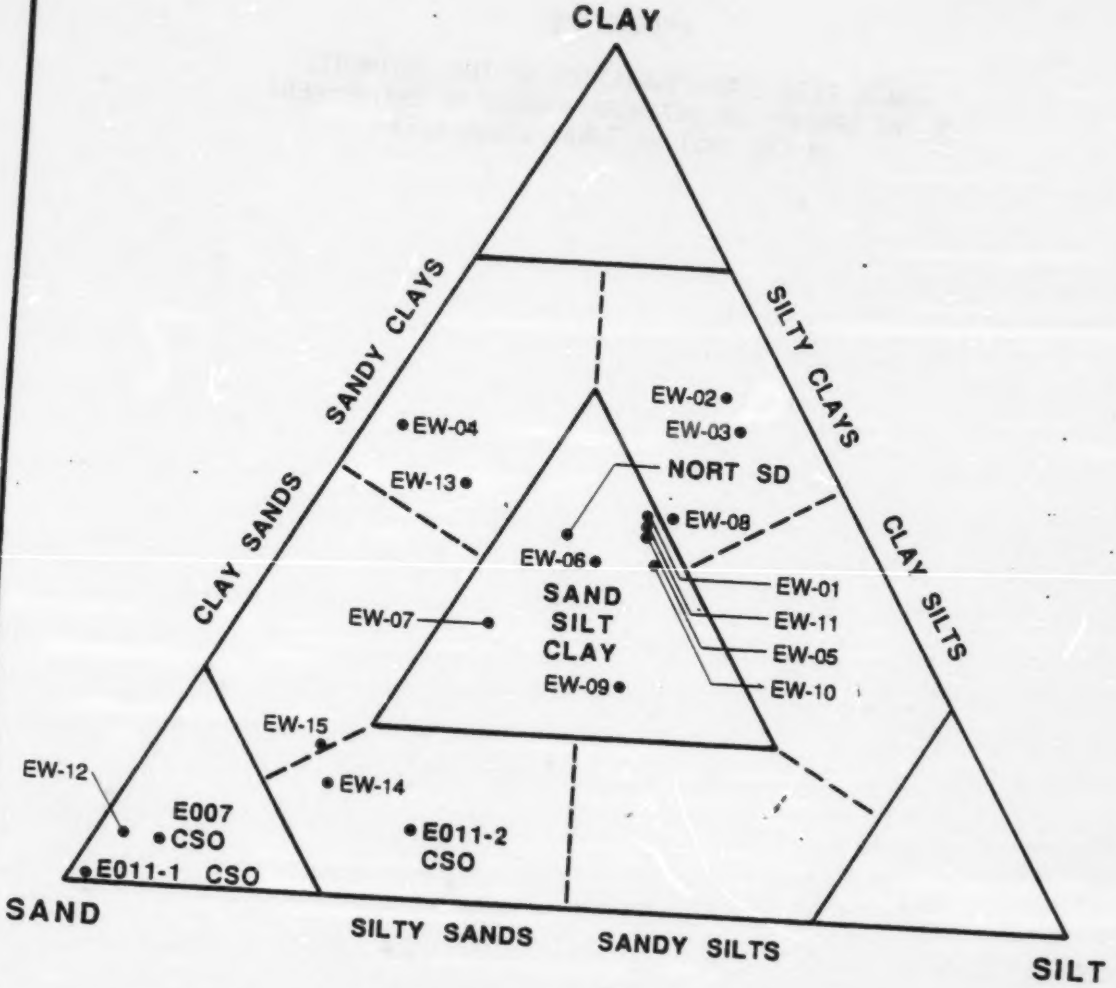

Figure D-1. Grain size characteristics of offshore and drain sediment samples collected from the East Waterway study area.

APPENDIX E

ELEVATION ABOVE REFERENCE VALUES FOR CHEMICALS OBSERVED IN DRAIN SEDIMENTS

TABLE E-1. EAR VALUES FOR SELECTED METALS FOUND IN EVERETT HARBOR DRAIN SEDIMENTS[a]

Compound	24th Street and Bond Street (CSO E007)	Lift Station #5 Manhole 1 (CSO E011-1)	Lift Station #5 Manhole 2 (CSO E011-2)	Norton Terminal Storm Drain (NORT)
Arsenic	2.2	--[b]	5.1	4.0
Cadmium	--	--	26.6	--
Chromium	12.6	10.9	12.4	8.9
Copper	8.2	2.2	34.1	11.1
Lead	21.5	3.9	42.7	4.0
Nickel	3.3	2.7	4.9	4.0
Zinc	11.4	7.2	520	10.6
Mercury	15.1	--	37.5	5.8
Silver	4.9	--	32.6	4.0
Selenium	--	--	1.3	--
Antimony	86.2	153	176	55

[a] EARs are calculated by dividing the measured concentration of a contaminant in a sediment by the measured concentration of the contaminant in sediment from a reference area. Mean reference concentrations in sediments from Carr Inlet were obtained from Tetra Tech (1988b).

[b] -- = Concentrations of contaminants less than those found in the reference area sediments (i.e., an EAR of less than 1).

TABLE E-2. (Continued)

Compound	24th Street and Bond Street (CSO E007)	Lift Station #5 Manhole 1 (CSO E011-1)	Lift Station #5 Manhole 2 (CSO E011-2)	Norton Terminal Storm Drain (NORT)
Benzo(a)pyrene	100	94.7	38.6	--
Indeno(1,2,3-cd)pyrene	81.2	56.2	35.4	--
Dibenzo(a,h)-anthracene	26.8	19.3	10.2	2.4
Benzo(g,h,i)-perylene	84.8	69.6	45.6	1.1
Total benzo-fluoranthenes	124	125	69	1.1
1,3-Dichloro-benzene	1.4	--	18.6	--
1,4-Dichloro-benzene	14.6	26.3	54.3	2.8
1,2-Dichloro-benzene	12	--	--	--
Benzoic acid	2.9	17.1	--	--
Dibenzofuran	45.9	351	184	--
N-nitroso-diphenylamine	9.8	--	43.9	5.6
2-Methyl-naphthalene	26.2	102	143	--
4'-DDT	2.6	--	--	--
Dieldrin	1.3	--	--	--
2-Chlorophenol	--	--	--	13.4
2,4-Dichloro-phenol	--	--	6.5	5.3

TABLE E-3. EAR VALUES FOR SELECTED PULP INDUSTRY-RELATED COMPOUNDS FOUND IN EVERETT HARBOR DRAIN SEDIMENTS[a]

Compounds	24th Street and Bond Street (CSO E007)	Lift Station #5 Manhole 1 (CSO E011-1)	Lift Station #5 Manhole 2 (CSO E011-2)	Norton Terminal Storm Drain (NORT)
2-Chlorophenol	---[b]	---	---	---
2,4-Dichlorophenol	---	---	6.5	5.3
2,4,6-Trichlorophenol	---	---	25	3.8
2,4,5-Trichlorophenol	---	---	3.7	14
2,3,4,6-Tetrachlorophenol	---	---	77	29
Pentachlorophenol	1.9	---	14	10
3,4,5-Trichloroguaiacol	---	---	---	---
4,5,6-Trichloroguaiacol	---	---	---	---
Tetrachloroguaiacol	---	---	---	---
Sandaracopimaric acid	---	---	---	2.6
Isopimaric acid	---	---	---	11
Dehydroabietic acid (DHA)	13	---	11	76
Abietic acid	4.4	---	---	---
Neoabietic acid	---	---	---	---
14-Chlorodehydroabietic acid	---	---	---	---
12-Chlorodehydroabietic acid	---	---	---	---
Dichlorodehydroabietic acid	---	---	---	---

[a] EARs are calculated by dividing the measured concentration of a contaminant in a sediment by the measured concentration of the contaminant in sediment from a reference area. Mean reference concentrations in sediments from Port Susan were obtained from PTI and Tetra Tech (1988b).

[b] -- = Concentrations of contaminants less than those found in the reference area sediments (i.e., an EAR of less than 1).

APPENDIX F

DREDGING HISTORY IN THE EVERETT HARBOR PROJECT AREA

APPENDIX F

DREDGING HISTORY IN THE EVERETT HARBOR PROJECT AREA

Information on historical dredging was compiled to determine the potential for these activities to disturb offshore sediments, and therefore, affect interpretation of spatial patterns of chemical contamination.

Recent dredge and fill activity in the Everett Harbor study area is primarily for channel maintenance and for dock and terminal construction (Figure F-1). Dredging operations are currently conducted by the U.S. Army Corps of Engineers, the Port of Everett, and private landowners. The U.S. Army Corps of Engineers is responsible for the greatest volume of dredging activity in the Snohomish River. Maintenance dredging of the main navigation channel has been performed every few years since 1969 (see Table F-1). Almost twice as much material has been removed from the upstream settling basin as from the downstream settling basin. The Port of Everett is planning a variety of activities to upgrade and expand facilities along the eastern shore of Port Gardner and the southern portion of the East Waterway. A series of dredging and filling projects will be associated with these actions. The U.S. Navy ("Homeport") plans to dredge approximately 3.305 million yd^3 of sediment from the East Waterway in different phases beginning in 1988, pending court appeals.

TABLE F-1. EVERETT HARBOR AND SNOHOMISH RIVER DREDGING SUMMARY 1969-1986

Year	Area Dredged	Volume (yd^3)
1969	Downstream basin and channel	452,704
1970-1	Upstream basin and channel	540,232
1974	Upstream basin and channel	278,500
1976-7	Downstream basin and channel	507,843
1978	East Waterway	131,919
1980	Upstream basin and channel	678,487
1983	Downstream basin and channel	208,427
1984	Upstream basin and channel	213,586
1986	Upstream basin and channel	181,582
Scheduled 1988	Upstream basin and channel	Estimated 350,000

Note: Dredged volumes from settling basins typically account for most of the total volume removed from basin and channel combined.

Reference: Arden, H. (8 June 1988, personal communication).

APPENDIX G

PUGET SOUND AIR POLLUTION REGISTRATION FILES IN THE EVERETT HARBOR PROJECT AREA

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PUGET SOUND AIR POLLUTION CONTROL AGENCY
200 W Mercer St #205, Seattle, WA 98119-3958
JUN 8, 1988, 1:09 PM

Registration File Listing

SNOHOMISH CO (PAINE FIELD) AIRPORT

Reg #:21400
DOE #: 83

BLDG C-1, PAINE FIELD
SNOHOMISH COUNTY 98204

Mail to:
3000 ROCKAFELLER AVE
EVERETT, WA 98204

WILLIAM DOLAN	AIRPORT INFORMATION OFFICER	353-2110
THOMAS WINTERS	SAFETY SPECIALIST	259-9413

UTM: 554.00 / 5306.00

1988 ANNUAL ASBESTOS NOTIFICATION #889010

SIC # 4512 SCHEDULED AIR TRANSPORTATION
EPA Program: SIP
Classification: A1

Inspection Record (CM File):

INSPECTED 12-02-83 HWD
12-24-84 RJG
12-11-85 RJG
02-12-87 MAM 2

Toxic Air Contaminant (TAC) Emissions (SP File):

		1986	1987
FORMALDEHYDE	=	1	1 Lb
NICKEL	=	4	4 Lb

Kg/Day
1986 1987

Air Contaminant Emissions:

	Tons/Year 1986	1987
TSPM	8	9
SOX	7	7
NOX	33	36
VOC	31	35
CO	616	730
PM10	7	9
TAC	0	0

```
                PUGET SOUND AIR POLLUTION CONTROL AGENCY
                       JUN 8, 1988,  1:09 PM

                       Registration File Listing
SNOHOMISH CO (PAINE FIELD) AIRPORT
----------------------------------                        Reg #:21400

Air Contaminant Emissions:
--------------------------
                   Kg/Day
                1986   1987
                ----   ----
       TSPM       20     22
       SOX        17     17
       NOX        82     89
       VOC        77     87
       CO       1531   1814
       PM10       17     22
       TAC         0      0
```

PUGET SOUND AIR POLLUTION CONTROL AGENCY
200 W Mercer St #205, Seattle, WA 98119-3958
JUN 8, 1988, 1:09 PM

Registration File Listing

BOEING COMMERCIAL AIRPLANE (EVERETT)

Reg #:13120
DOE #: 39

3003 W CASINO RD, EVERETT
SNOHOMISH COUNTY 98201

Mail to:
PO BOX 3707 MS OH-26
SEATTLE, WA 98124

FRED STEWART	FACILITIES ENGINEERING MANAGER	342-1130
CONNIE CARLSON	POLLUTION CONTROL ENGINEER	342-0871

UTM: 554.00 / 5307.40

1988 ANNUAL ASBESTOS NOTIFICATION #889045

SIC # 3721 AIRCRAFT
EPA Program: SIP

Classification: A1

Inspection Record (CM File):

INSPECTED	06-13-81	RJG/AKN
	09-16-81	HWD
	12-10-81	HWD
	09-29-82	RJG
	07-13-83	HWD
	06-13-84	HWD
	01-07-85	RJG
	07-18-85	RJG
	09-29-86	JLH 2
	08-27-87	PBB 2

Toxic Air Contaminant (TAC) Emissions (SP File):

		1986	1987
ACETONE		----	----
AMMONIA	=	7	12 Ton
BUTANONE (METHYL ETHYL KETONE)	=	1962	1593 Lb
BUTYL ACETATE	=	192	275 Ton
BUTYL ALCOHOL	=	30	9 Ton
BUTYROLACTONE	=	1047	1598 Lb
CHROMIUM	=	0	3 Ton
CYCLOHEXANONE	=	10	2 Lb
ETHOXYETHYL ACETATE (CELLOSOLVE ACETATE)	=	32	41 Ton
ETHYL ACETATE	=	27	34 Ton
ETHYLENE GLYCOL	=	15	6 Ton
ETHYLENE GLYCOL MONOBUTYL ETHER (BUTYL CELLOSOLVE)	=	6	5 Ton
FORMALDEHYDE	=	0	7 Ton
	=	124	31 Lb

PUGET SOUND AIR POLLUTION CONTROL AGENCY
JUN 8, 1988, 1:09 PM

Registration File Listing

BOEING COMMERCIAL AIRPLANE (EVERETT)

Reg #:13120

Toxic Air Contaminant (TAC) Emissions (SP File):

		1986	1987
ISOPROPYL ALCOHOL	=	13	24 Ton
MANGANESE	=	6	1 Lb
METHYL PENTANONE (METHYL ISOBUTYL KETONE)	=	7	10 Ton
NICKEL	=	203	48 Lb
SYNTHETIC RESIN	=	5	3 Ton
TOLUENE	=	128	105 Ton
TRICHLOROETHANE	=	222	26 Ton
TRICHLOROETHYLENE	=	4	2 Ton
XYLENE	=	43	59 Ton

		Kg/Day	
		1986	1987
ACETONE	=	16	31
AMMONIA	=	2	2
BUTANONE (METHYL ETHYL KETONE)	=	478	683
BUTYL ACETATE	=	76	22
BUTYL ALCOHOL	=	1	2
BUTYROLACTONE	=	0	7
CYCLOHEXANONE	=	78	101
ETHOXYETHYL ACETATE (CELLOSOLVE ACETATE)	=	67	85
ETHYL ACETATE	=	38	14
ETHYLENE GLYCOL	=	15	12
ETHYLENE GLYCOL MONOBUTYL ETHER (BUTYL CELLOSOLVE)	=	0	18
ISOPROPYL ALCOHOL	=	32	59
METHYL PENTANONE (METHYL ISOBUTYL KETONE)	=	17	26
SYNTHETIC RESIN	=	12	7
TOLUENE	=	319	262
TRICHLOROETHANE	=	552	64

PUGET SOUND AIR POLLUTION CONTROL AGENCY
JUN 8, 1988, 1:09 PM

Registration File Listing

BOEING COMMERCIAL AIRPLANE (EVERETT) Reg #:13120

Toxic Air Contaminant (TAC) Emissions (SP File):

		Kg/Day 1986	Kg/Day 1987
TRICHLOROETHYLENE	=	10	5
XYLENE	=	108	147

Air Contaminant Emissions:

	Tons/Year 1986	Tons/Year 1987
TSPM	21	14
SOX	207	55
NOX	217	222
VOC	754	860
CO	5807	6423
PM10	20	14
TAC	733	623

	Kg/Day 1986	Kg/Day 1987
TSPM	52	35
SOX	514	137
NOX	539	552
VOC	1874	2138
CO	14433	15964
PM10	50	35
TAC	1821	1548

[illegible]
200 W Mercer St #205, Seattle, WA 98119-3958
JUN 8, 1988, 1:09 PM

Registration File Listing

ASSOCIATED SAND AND GRAVEL CO INC

Reg #:10169
DOE #: 3

6300 GLENWOOD AVE, EVERETT
SNOHOMISH COUNTY 98203

Mail to:
PO BOX 2037
EVERETT, WA 98203

DALE SURDYK	MANAGER	624-0301
GERALD CRANE	MANGR PROPERTY & ENGR	355-2111

UTM: 556.80 / 5309.72

SIC # 3273 READY-MIXED CONCRETE
EPA Program: SIP NSPS

Classification: A1

Inspection Record (CM File):

INSPECTED	11-12-81 HWD
	05-13-82 HWD
	06-30-83 RJG
	09-27-83 JKA
	05-14-84 HWD
	05-23-84 HWD
	05-15-85 RJG
	07-07-86 RJG 2
	07-15-86 RJG 2
	08-25-87 JLH 2
	04-14-88 RJG 1

Toxic Air Contaminant (TAC) Emissions (SP File):

		1986	1987	
CHROMIUM	=	3	4	Lb
FORMALDEHYDE	=	3	3	Ton
MANGANESE	=	2	2	Lb
NICKEL	=	63	72	Lb

		Kg/Day 1986	1987
FORMALDEHYDE	=	7	8

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

ASSOCIATED SAND AND GRAVEL CO INC
-------------------------------- Reg #:10169

Air Contaminant Emissions:

	Tons/Year	
	1986	1987
TSPM	208	224
SOX	0	0
NOX	8	9
VOC	0	0
CO	2	2
PM10	37	38
TAC	3	3

	Kg/Day	
	1986	1987
TSPM	517	557
SOX	0	0
NOX	20	22
VOC	0	0
CO	5	5
PM10	92	94
TAC	8	8

```
                 PUGET SOUND AIR POLLUTION CONTROL AGENCY
               200 W Mercer St #205, Seattle, WA  98119-3958
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                         Registration File Listing

  U S DEFENSE FUEL SUPPLY AGENCY DLA
  ----------------------------------                        Reg #:16000
                                                            DOE #:   78
    FRONT & PARK ST, MUKILTEO                       Mail to:
    SNOHOMISH COUNTY  98275                         DFSC-FQ CAMERON STATION
                                                    ALEXANDER, VA  22304-6160
    W E GOODE/HASAN DOGRUL     CHIEF ENVIR QUALITY DIV/CONTACT      274-6989
    JIM REYNOLDS/GEORGE HELMS  SUPERINTENDENT/REGIONAL ENGINEER     355-2051

    UTM: 552.50 / 5310.70


    SIC # 5171 PETROLEUM BULK STATIONS AND TERMINALS
    EPA Program: SIP
                                       Classification: A1
  Inspection Record (CM File):
  ----------------------------
    INSPECTED 11-15-83 RJG
              11-08-84 RJG
              12-11-85 RJG
              02-19-87 MAM 2
              07-08-87 PBB 2

  Air Contaminant Emissions:
  --------------------------

                       Tons/Year
                      1986   1987
                      ----   ----
              TSPM       0      0
              SOX        0      0
              NOX        0      0
              VOC       42     20
              CO         0      0
              PM10       0      0
              TAC        0      0

                        Kg/Day
                      1986   1987
                      ----   ----
              TSPM       0      0
              SOX        0      0
              NOX        0      0
              VOC      104     50
              CO         0      0
              PM10       0      0
              TAC        0      0
```

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

TIZ'S DOOR SALES INC

Reg #:16338
DOE #:

2118 38TH ST, EVERETT
SNOHOMISH COUNTY 98201-5021

Mail to:
PO BOX 1078
EVERETT, WA 98206

PAT MAAHS PRODUCTION MANAGER 259-4437

UTM: 559.80 / 5312.80

SIC # 2431 MILLWORK
EPA Program: SIP

Classification: B

Inspection Record (CM File):

INSPECTED 12-20-83 HWD
12-11-84 RJG
11-01-85 RJG
11-26-86 JLH 2
08-27-87 PBB 2

Toxic Air Contaminant (TAC) Emissions (SP File):

		1986	1987	
TOLUENE	=	11	11	Ton

		Kg/Day 1986	1987
TOLUENE	=	29	27

Air Contaminant Emissions:

	Tons/Year 1986	1987
TSPM	0	0
SOX	0	0
NOX	0	0
VOC	13	12
CO	0	0
PM10	0	0
TAC	11	11

```
                PUGET SOUND AIR POLLUTION CONTROL AGENCY
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                      Registration File Listing
TIZ'S DOOR SALES INC
--------------------
                                                            Reg #:16338
Air Contaminant Emissions:
--------------------------
                     Kg/Day
                   1986   1987
                   ----   ----
     TSPM             0      0
     SOX              0      0
     NOX              0      0
     VOC             32     30
     CO               0      0
     PM10             0      0
     TAC             27     27
```

```
                    PUGET SOUND AIR POLLUTION CONTROL AGENCY
                 200 W Mercer St #205, Seattle, WA  98119-3958
                          JUN  8, 1988,  1:09 PM

                         Registration File Listing

    PROVIDENCE HOSPITAL
    -------------------
                                                          Reg #:16006
                                                          DOE #:
      916 PACIFIC AVE, EVERETT                     Mail to:
      SNOHOMISH COUNTY  98201                      PO BOX 1067
                                                   EVERETT, WA  98206-1067

      CARL MUNDING/WALT SALINE  ADMINISTRATOR/ADMIN DIR BU SERV  258-7123
      EUGENE GOEHRS             CHIEF ENGINEER                   258-7854

      UTM: 558.55 / 5313.75


      SIC # 8062 GENERAL MEDICAL AND SURGICAL HOSPITALS
      EPA Program: SIP
                                       Classification: B
    Inspection Record (CM File):
    ----------------------------
      INSPECTED 06-25-81 RJG
                06-09-82 HWD
                06-23-83 RJG
                11-06-84 RJG
                10-16-85 RJG
                02-11-87 JLH 2

    Toxic Air Contaminant (TAC) Emissions (SP File):
    ------------------------------------------------

                                                   1986      1987
     ETHYLENE OXIDE                                ----      ----
                                          =        1680      1700 Lb

                                                       Kg/Day
                                                   1986      1987
     ETHYLENE OXIDE                                ----      ----
                                          =           2         2
    Air Contaminant Emissions:
    --------------------------

                        Tons/Year
                       1986   1987
                       ----   ----
            TSPM          0      0
            SOX           0      0
            NOX           0      0
            VOC           0      0
            CO            0      0
            PM10          0      0
            TAC           1      1
```

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

PROVIDENCE HOSPITAL

Reg #:16006

Air Contaminant Emissions:

	Kg/Day 1986	Kg/Day 1987
TSPM	0	0
SOX	0	0
NOX	0	0
VOC	0	0
CO	0	0
PM10	0	0
TAC	2	2

```
               PUGET SOUND AIR POLLUTION CONTROL AGENCY
             200 W Mercer St #205, Seattle, WA  98119-3958
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                     Registration File Listing

SCOTT PAPER CO NORTHWEST OPERATIONS
-----------------------------------                          Reg #:12164
                                                             DOE #:   70
  2600 FEDERAL AVE, EVERETT                       Mail to:
  SNOHOMISH COUNTY  98201                         PO BOX 925
                                                  EVERETT, WA  98206-0925

  TIMOTHY BECHTEL  ENVIRONMENTAL MANAGER  259-7393
  ALEX M. HOOD     UTILITIES MGR          259-7482

  UTM: 558.50 / 5314.60


  SIC # 2621 PAPER MILLS
  EPA Program: SIP NESHAP                  Classification: A1

Inspection Record (CM File):
----------------------------
  INSPECTED 11-09-81 HWD
            05-19-82 HWD
            05-23-83 RJG
            05-16-84 HWD
            05-30-85 RJG
            02-27-87 JLH 2
            07-08-87 PBB 2
            03-22-88 RJG 1

Toxic Air Contaminant (TAC) Emissions (SP File):
------------------------------------------------
                                                1986     1987
 CHLORINE                                       ----     ----
 CHLOROFORM                              =       600        0 Lb
 CHROMIUM                                =        22       22 Ton
 DIOXINS                                 =         1        3 Lb
 FORMALDEHYDE                            =         9        9 Lb
 MANGANESE                               =        23       30 Lb
 NICKEL                                  =         1        2 Lb
 POM (POLYCYCLIC ORGANIC MATTER)         =        27       55 Lb
 XYLENE                                  =      1023     1013 Lb
                                         =        78       45 Ton

                                                   Kg/Day
                                                1986     1987
 CHLORINE                                       ----     ----
 CHLOROFORM                              =         1        0
                                         =        56       56
```

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

SCOTT PAPER CO NORTHWEST OPERATIONS

Reg #:12164

Toxic Air Contaminant (TAC) Emissions (SP File):

		Kg/Day	
		1986	1987
POM (POLYCYCLIC ORGANIC MATTER)	=	1	1
XYLENE	=	195	112

Air Contaminant Emissions:

	Tons/Year	
	1986	1987
TSPM	456	454
SOX	373	405
NOX	1310	1318
VOC	257	223
CO	3435	3404
PM10	373	371
TAC	101	68

	Kg/Day	
	1986	1987
TSPM	1133	1128
SOX	927	1007
NOX	3256	3276
VOC	639	554
CO	8538	8461
PM10	927	922
TAC	251	168

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

EVERETT PORT FACILITIES

Reg #:14024
DOE #: 9

PIER 1, EVERETT
SNOHOMISH COUNTY 98201

Mail to:
PO BOX 538
EVERETT, WA 98206-0538

PHIL BANNON	DIRECTOR	259-3164
ED PASKOVSKIS	OPERATIONS MNGR	259-3164

UTM: 558.00 / 5314.00

SIC # 4491 MARINE CARGO HANDLING
EPA Program: SIP

Classification: A1

Inspection Record (CM File):

INSPECTED 11-05-81 HWD
07-14-82 RJG
11-10-82 RJG
06-13-83 RJG
12-12-83 HWD
11-14-84 RJG
10-24-85 RJG
10-24-85 RJG
02-05-87 JLH 2
08-31-87 PBB 2

Air Contaminant Emissions:

	Tons/Year	
	1986	1987
TSPM	186	185
SOX	0	0
NOX	0	0
VOC	0	0
CO	0	0
PM10	7	7
TAC	0	0

	Kg/Day	
	1986	1987
TSPM	462	460
SOX	0	0
NOX	0	0
VOC	0	0
CO	0	0
PM10	17	17
TAC	0	0

PUGET SOUND AIR POLLUTION CONTROL AGENCY
200 W Mercer St #205, Seattle, WA 98119-3958
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Registration File Listing

SOUND CASKET MFG. CO., INC.

Reg #:14121
DOE #:

2815 BAKER AVE, EVERETT
SNOHOMISH COUNTY 98201

Mail to:
PO BOX 1023
EVERETT, WA 98206-1023

KEN WASHO	PRESIDENT	259-6012
E.R. CHRISTENSEN	MANAGER	259-6012

UTM: 560.13 / 5314.19

SIC # 3995 BURIAL CASKETS
EPA Program: SIP

Classification: B

Inspection Record (CM File):

INSPECTED	10-21-83	HWD
	11-06-84	RJG
	10-29-85	RJG
	02-05-87	JLH 2
	09-08-87	PBB 2
	10-06-87	PBB 2

Toxic Air Contaminant (TAC) Emissions (SP File):

		1986	1987
ACETONE	=	242	250 Lb
BUTANONE (METHYL ETHYL KETONE)	=	958	990 Lb
BUTYL ALCOHOL	=	242	250 Lb
HEXANE	=	1917	1980 Lb
ISOPROPYL ALCOHOL	=	242	250 Lb
METHANOL (METHYL ALCOHOL)	=	242	250 Lb
NAPHTHA VM&P	=	242	250 Lb
TOLUENE	=	484	500 Lb

		Kg/Day	
		1986	1987
BUTANONE (METHYL ETHYL KETONE)	=	1	1
HEXANE	=	2	2
TOLUENE	=	1	1

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

SOUND CASKET MFG. CO., INC. Reg #:14121

Air Contaminant Emissions:

	Tons/Year 1986	1987
TSPM	0	0
SOX	0	0
NOX	0	0
VOC	2	2
CO	0	0
PM10	0	0
TAC	2	2

	Kg/Day 1986	1987
TSPM	0	0
SOX	0	0
NOX	0	0
VOC	5	5
CO	0	0
PM10	0	0
TAC	6	6

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

CENTRECON INC

Reg #:11271
DOE #: 88

1130 W MARINE VIEW DR, EVERETT
SNOHOMISH COUNTY 98201

Mail to:
PO BOX 28
EVERETT, WA 98206-0028

JAMES SCHACK	PRESIDENT	258-2616
ROBERT SCHARF	PLANT SUPERINTENDENT	258-2616

UTM: 558.70 / 5316.55

SIC # 3272 CONCRETE PRODUCTS
EPA Program: SIP

Classification: B

Inspection Record (CM File):

INSPECTED 12-07-82 RJG
12-14-83 HWD
12-20-84 RJG
11-19-85 RJG
02-05-87 JLH 2
08-26-87 PBB 2

Air Contaminant Emissions:

	Tons/Year	
	1986	1987
TSPM	12	12
SOX	0	0
NOX	0	0
VOC	0	0
CO	0	0
PM10	1	1
TAC	0	0

	Kg/Day	
	1986	1987
TSPM	30	30
SOX	0	0
NOX	0	0
VOC	0	0
CO	0	0
PM10	2	2
TAC	0	0

PUGET SOUND AIR POLLUTION CONTROL AGENCY
200 W Mercer St #205, Seattle, WA 98119-3958
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Registration File Listing

NORD/JELD-WEN OF EVERETT INC

Reg #:10663
DOE #: 17

300 W MARINE VIEW DR, EVERETT
SNOHOMISH COUNTY 98201

Mail to:
PO BOX 1187
EVERETT, WA 98206-1187

RONALD J MINER	GENERAL MANAGER	259-9292
LEON WELLS	MAINTENANCE MANAGER	259-9292

UTM: 558.91 / 5317.90

SIC # 2431 MILLWORK
EPA Program: SIP

Classification: A1

Inspection Record (CM File):

INSPECTED 01-06-81 RJG
06-24-81 RJG
01-14-82 HWD
06-17-82 HWD
01-19-83 RJG
06-27-84 HWD
01-24-85 RJG
06-17-86 RJG 1
07-14-87 PBB 2

Toxic Air Contaminant (TAC) Emissions (SP File):

		1986	1987	
ACETALDEHYDE	=	1920	1730	Lb
FORMALDEHYDE	=	2	2	Ton
MANGANESE	=	4	4	Ton
PHENOL	=	8	7	Ton
POM (POLYCYCLIC ORGANIC MATTER)	=	32	29	Lb

		Kg/Day	
		1986	1987
ACETALDEHYDE	=	2	2
FORMALDEHYDE	=	5	4
MANGANESE	=	10	9
PHENOL	=	20	18

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

NORD/JELD-WEN OF EVERETT INC
----------------------------- Reg #:10663

Air Contaminant Emissions:

	Tons/Year	
	1986	1987
TSPM	154	167
SOX	0	0
NOX	11	10
VOC	6	5
CO	104	94
PM10	110	112
TAC	15	14

	Kg/Day	
	1986	1987
TSPM	383	415
SOX	0	0
NOX	27	25
VOC	15	12
CO	258	234
PM10	273	278
TAC	37	34

PUGET SOUND AIR POLLUTION CONTROL AGENCY
200 W Mercer St #205, Seattle, WA 98119-3958
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Registration File Listing

ALPINE RETREADERS (J&V INVESTMENTS)

Reg #:12425
DOE #:

406 SE EVERETT MALL WAY #104, EVERETT
SNOHOMISH COUNTY 98208

Mail to:
2701 WALNUT AVE
EVERETT, WA 98201

JOHN BRONSON	OWNER	259-0814
KEN EPPERLY	MANAGER	347-5626

UTM: 560.60 / 5317.70

SIC # 7534 TIRE RETREADING AND REPAIR SHOPS
EPA Program: SIP

Classification: B

Inspection Record (CM File):

INSPECTED	04-08-81	JLH	
	09-23-81	HWD	
	07-09-82	RJG	
	07-14-83	HWD	
	07-31-84	RJG	
	08-05-85	RJG	
	11-20-85	RJG	
	02-02-87	JLH	2
	09-04-87	PBB	2
	02-17-88	RJG	2

Toxic Air Contaminant (TAC) Emissions (SP File):

		1986	1987	
HEXANE	=	2	2	Ton

Kg/Day

		1986	1987
HEXANE	=	5	5

Air Contaminant Emissions:

	Tons/Year	
	1986	1987
TSPM	0	0
SOX	0	0
NOX	0	0
VOC	2	2
CO	0	0
PM10	0	0
TAC	2	2

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

ALPINE RETREADERS (J&V INVESTMENTS) Reg #:12425

Air Contaminant Emissions:

	Kg/Day 1986	Kg/Day 1987
TSPM	0	0
SOX	0	0
NOX	0	0
VOC	5	5
CO	0	0
PM10	0	0
TAC	5	5

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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JUN 8, 1988, 1:09 PM

Registration File Listing

WEYERHAEUSER CO, KRAFT MILL

Reg #:12754
DOE #: 8

101 E MARINE VIEW DR, EVERETT
SNOHOMISH COUNTY 98201

Mail to:
101 E MARINE VIEW DR
EVERETT, WA 98201

WILLIAM P MILLER 339-2800
HAROLD RUPPERT ENVIRONMENTAL SUPERVISOR 339-2868

UTM: 560.30 / 5318.30

SIC # 2611 PULP MILLS
EPA Program: SIP

Classification: A1

Inspection Record (CM File):

```
INSPECTED 05-21-81 RJG
          06-23-82 HWD
          06-28-83 RJG
          06-27-84 HWD
          12-16-85 RJG
          10-16-86 JLN 2
          03-16-88 RJG 1
          03-16-88 RJG 1
```

Toxic Air Contaminant (TAC) Emissions (SP File):

```
                                         1986     1987
CHLORINE                                 ----     ----
CHLOROFORM                         =       23        0 Ton
CHROMIUM                           =       20       21 Ton
FORMALDEHYDE                       =       34       25 Lb
HYDROGEN SULFIDE                   =      160      119 Lb
MANGANESE                          =       32        0 Ton
NICKEL                             =       19       14 Lb
POM (POLYCYCLIC ORGANIC MATTER)    =      677      504 Lb
                                   =        1        1 Lb

                                            Kg/Day
                                         1986     1987
CHLORINE                                 ----     ----
CHLOROFORM                         =       57        0
HYDROGEN SULFIDE                   =       51       53
NICKEL                             =       80        0
                                   =        1        1
```

PUGET SOUND AIR POLLUTION CONTROL AGENCY
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Registration File Listing

WEYERHAEUSER CO, KRAFT MILL Reg #:12754

Air Contaminant Emissions:

	Tons/Year 1986	Tons/Year 1987
TSPM	538	549
SOX	1023	840
NOX	159	147
VOC	4	3
CO	943	993
PM10	285	287
TAC	75	21

	Kg/Day 1986	Kg/Day 1987
TSPM	1337	1365
SOX	2543	2088
NOX	395	365
VOC	10	7
CO	2344	2468
PM10	708	713
TAC	188	53